THE

ELECTRICAL REVIEW.

VOL. LVIII. JUNE 15, 1906. No. 1,490.

ELECTRICAL REVIEW.

Vol. LVIII.] CONTENTS: June 15, 1906. [No. 1,490.

	Page
India-Rubber Cultivation	945
Some Notes on Braking Devices (*illus.*)	948
Rapid Methods for Producing Electrotypes (*illus.*)	949
Correspondence	952
Legal	957
Parliamentary	959
Business Notes	959
The Gillingham Electricity Undertaking (*illus.*)	963
The British School of Telegraphy (*illus.*)	967
City Notes	971
Market Quotations	974
Stocks and Shares	974
Share List of Electrical Companies	975
New Electrical Devices, Fittings and Plant (*illus.*)	977
The King Edward VII. Sanatorium (*illus.*)	978
The Continental Electrical Engineering Industry	979
The Efficiency of Condensers and its Effect on Power Station Costs	980
Standardisation of Rubber Mixtures	981
Note on the Indicator Diagram of the Willans Engine (*illus.*)	982
The Hustler	982
New Patents Applied For	983
Published Specifications	984

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone No. 933 Holborn; 4425 Central.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free, per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street Paris: VEUVE J. BOYVEAU, 23, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE

UNIVERSAL ELECTRICAL DIRECTORY

1906 Edition

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

INDIA-RUBBER CULTIVATION.

THE letter of a correspondent on the above subject, which appears in our issue of to-day, raises a question of great importance to the various companies which have lately sprung into existence for the production of india-rubber from Para trees cultivated in Ceylon and other suitable parts of the tropics, in competition with the product of the uncultivated and uncared-for tree, growing—as those in the Amazon delta, for instance—amid dense jungle, and except for the wonderful soil and suitability of the climate, under every disadvantage and in spite of every obstacle. From this region alone comes about one-half of the world's total supply, and the uninitiated may well fail to understand how plantations can hope to compete against the natural rubber forests which we are led to believe still cover enormous areas of country in Brazil and other parts of the world. But the collection from these forests, or rather from the rubber trees scattered about in them, is so difficult, and various expenses and charges increase the cost of delivery in Europe and America to such a figure that careful consideration leads one to think that under favourable labour conditions rubber planting is a sound industry.

We have expressed opinions from time to time which have been favourable to the new enterprise, and, without pretending to be botanical experts, we propose to state some of the *pros* and *cons* of the matter. Our correspondent's case, in a few words, is this: He says, if the latex, or sap, is taken away from an immature, or baby, tree, it will cause weakness, and render the tree so liable to be attacked by fungoid growths as to lead to its destruction, and render the rubber plantations unremunerative.

The crux of the whole matter is this: Assuming that favourable localities exist outside the natural rubber forests for the cultivation of the Hevea braziliansis tree, and there is little doubt of this, at what age can the tree be tapped, and to what extent, without injury either directly or subsequently by disease? Experience gained from experiments carried on with great care and skill for many years past has led to the conclusion that on an average a cultivated tree can safely be tapped at the age of five or six years, by which time it should be about 40 ft. high and 20 in. in girth at a yard from the ground, and can hardly be considered a "baby." A fair estimate of the yield is said to be ½ lb. in the fifth year, double that in the sixth, and 2 lb. in the seventh or eighth year, while a mature healthy tree, say, 15 years old, according to Mr. J. Nisbet, who was formerly Conservator of Forests, Burma, should yield upwards of 5 lb. of dry rubber yearly. The question as to the age at which a tree should be tapped is largely a matter of cost—obviously very small quantities will not pay for collection. Our correspondent remarks that we have never yet heard of any blight affecting the trees in Brazil, and accounts for this by the fact that they have all reached maturity before falling into the hands of the collector. He is certainly wrong in thinking that only

mature trees are tapped. The professional rubber gatherer, of all human beings the most careless of the future, and mindful only of his own interests for the two or three seasons he is likely to be able to survive the combined effects of a bad climate and evil living, taps every tree he comes across, and gets as much out of each as he can, often by methods calculated to do the maximum amount of harm to the tree. That rubber trees have not long ago been killed off, except in comparatively inaccessible regions, is a strong testimony to their hardihood, and it is difficult to believe that if they have withstood such treatment, in addition to being handicapped by their surrounding of dense jungle, the cultivated and properly cared for tree can fail to be successful. Like many other trees and plants, the rubber tree is subject to fungoid diseases, and also to the attacks of insect pests, but it is not unreasonable to suppose that much of this can be obviated by modern scientific methods, and up to the present no disease has been discovered which seriously affects this tree. A writer, who seems to know his subject*, and from whom we quote the above figures as to the yield of trees, thinks that the Para rubber tree is quite as hardy as the tea plant, and cites in support the fact that it flourishes under a rainfall of 250 in., or of 65 in. a year, whether in the hot, dry, low country of the Eastern coast of Ceylon, or in the moister zone of the western portion of the island, whether at sea level or an elevation of over 2,000 ft., and whether in alluvial soil, or on a river bank. That plantations will pay under all these varying conditions is, of course, too much to expect. No doubt a great deal of land which is idle and unremunerative owing to the failure of cinchona and coffee will be put on the market as suitable for india-rubber, and the results, though possibly pleasing to the original owners, will hardly be so to anyone else. The successes which are likely to be achieved by the best of the ventures should in no way lead the future investor to omit any of the inquiries and precautions which are always advisable, and should certainly not be neglected in the case of india-rubber.

As regards the botanical side of the question, our correspondent is probably wrong in thinking that the latex can be compared to the life blood of the tree; most authorities agree that it is an excretory matter of little use to it; and if it could all be extracted without mechanical injury, probably its loss would not be felt. M. Bonnechaux, a man who spent years studying the methods of collection, states that on the Amazon he has seen trees tapped for 180 consecutive days, and after a rest of six months the tree yielded again as freely and appeared none the worse. Instances have been known of trees which have been subjected to this treatment for eighty years.

It is not, to our minds, a question of whether the india-rubber tree can be successfully cultivated in favourable localities away from its natural habitat—all that has been settled thirty or forty years ago—but rather what limits must be placed on the wonderful power of the trees in adapting themselves to unnatural conditions both as regards soil and climate, and in repairing under unfavourable circumstances the mechanical injury to the bark caused by the tapping.

Factory Scale Experiments with Fused Electrolytes.

OF recent years the possibility of reducing metals electrolytically from their fused sulphides has formed the subject of much interesting work. It must always be borne in mind that in such a process a maximum yield of product is theoretically obtainable, for the deposits at both the cathode and anode are of market value. Further, loss of material by volatilisation due to overheating and air currents is practically negligible. Thus the newer processes have a great advantage over the older fusion and roasting methods and are bound to be adopted in the future wherever a cheaper supply of electrical power is available. The treatment, therefore, of a subject of such widespread importance by Edgar A. Ashcroft (*Electrochemical and Metallurgical Industry*, May, 1906) is extremely interesting. In working such a process the choice of a suitable fusion bath is the first and most important difficulty to be dealt with. Many conditions must be satisfied. In the first place, the bath must form with the sulphide a mixture of low fusion point. It must, above all, be stable in heat, and not materially affected by the current to be used. The conditions chosen, further, must be such that only the required metal is deposited at the cathode, but, at the same time, the plant must not become clogged with accumulated impurities. These conditions are best fulfilled in the case of such chlorides of the metals lead, zinc or sodium. The first process discussed by the author is the reduction of zinc blend proposed originally by Swinburne (English patent, 1898). The bath consists of molecular quantities of sodium chloride and zinc chloride kept at a temperature of 450° C. and the working E.M.F. should not exceed 2·5 volts. The sulphur from the anode may be collected or oxidised to sulphur dioxide for use in the manufacture of sulphuric acid. This process works well for pure blends, but is otherwise useless, and its future, according to the author, is not very bright. If, however, a combined fusion and electrolytic process were adopted, there seems no reason why success should not be ensured. A similar process is discussed in the case of lead sulphide; but here again the same obstacles are to be met. In cases where antimony and arsenic sulphides are present, readily volatile chlorides are formed, and an easy means of purification is obtained. Iron, silver and copper impurities present very little difficulty, as these interact with the deposited metal, and may be removed as a scum. Finally, a new form of magnetic cell is described, whose chief novelty lies in the use of hollow anodes for the removal of the liberated gases, whereby a closed form of apparatus is not needed.

Underground Cables in China.

IN the *Electrical Review*, New York, of May 19th, Mr. Lewis G. Martin writes an interesting article, illustrated with several photographs, entitled "The last link of the all-American Pacific Cable." As a matter of fact, it is a chatty account of the laying of the underground lines between the Shanghai office and the landing-place of the Commercial Pacific Cable Co.'s Shanghai-Manila cable opposite the Chinese city of Pao-Shan.

The total length of the line is nearly 14½ miles, of which 1·8 miles is through the International Settlement at Shanghai, 10 miles along the side of the Shanghai-Woosung Forts railway, and the remainder across open agricultural country. Four conductors are provided, each weighing 116 lb. per mile, and insulated to a thickness of $\frac{3}{32}$ in.; each of these cores is taped and lead-covered, and the four are again enclosed in lead and finally drawn into a 2-in. galvanised wrought-iron pipe laid in a trench and provided with cast-iron junction boxes every one-eighth of a mile. The whole work was carried out by the Okonite Co., Ltd., of New York. The German-Dutch Telegraph Co. took advantage of the situation, and with the assistance of the Great Northern Telegraph Co., laid their Shanghai-Woosung cables in the same trench. These were of a less costly kind, and consisted of a two-cored cable armoured in the usual way, each core having metallic protection. The Imperial Chinese Telegraph Department also used part of the trench for a six-conductor lead-covered and steel-taped cable.

Mr. Martin duly acknowledges the great assistance and kindness he received from Mr. Chow Wan Pang, the acting general manager of the Imperial Chinese Telegraph Administration, Mr. F. N. Dressing, chief superintendent of the same, and from Mr. W. Schönau, the chief engineer in Far East of the Great Northern Telegraph Co. Like everybody else, Mr. Martin found Chinese Labour most satisfactory.

* "The Prospects of Rubber Cultivation in Ceylon," by Henry M. Alleyn, planter.

The Co-operation of German Works.

The tendency is growing in Germany for the large electrical engineering works to co-operate with each other where their interests are identical or where common action would be more advantageous than individual enterprise.

As the latest example it has just transpired that the Allgemeine Co., the Siemens & Halske Co., and the Felten and Guilleaume-Lahmeyer Co., recently arrived at an agreement in regard to the Russian business in cables, copper and conductors, and established in place of their separate undertakings a joint concern under the title of the United Cable Works of St. Petersburg, with a share capital of £600,000. Of former instances of common action there may be recalled the co-operation of the Allgemeine Co. and the Siemens & Halske Co. in Warsaw, Valparaiso and other places; the joint activity of the two companies in the International Glow Lamp Syndicate, in the matter of wireless telegraphy and the electric lighting of trains. In addition to these the two companies took over the Cologne works of the Helios Co., worked out the scheme for a high speed electric railway between Berlin and Hamburg, and they are proceeding with the construction of the city and suburban railway at Hamburg, while the ring of the large electrical companies around the batteries of the Berlin-Hagen Accumulator Co. is also attributed to them. Notwithstanding the many instances of co-operation, free competition still exists on a large scale in Germany, and it is not assumed that the concentration movement will exceed the bounds of united action in regard to agreements respecting individual cases as they may arise.

The Licensing of Electrical Wiremen.

From time to time suggestions have been thrown out as to the need of some kind of registration of electrical wiremen. The practice in the plumbing trade, in which the term "registered plumber" is now a kind of guarantee of competency, is used as an argument in favour of the proposal. There is certainly as much, if not more, need for the employment of competent men in electrical work, as in plumbing work, as the results of bad workmanship in the one case may be very much more serious than in the other. In this matter it might appear that our Colonies are more progressive than we in this country. Certain by-laws have been framed by the Sydney City Council which provide that any electrical wiremen desirous of obtaining a license shall make application to the City electrical engineer. He is required to produce evidence that he is of good character and that he has served for at least two years at the wiring trade. The license is issued by the town clerk upon receiving the application, proof, particulars, and a fee of 5s., and providing also that the wireman is over 21 years of age. The license is not a perpetual one, but remains in force till the end of the then current year, when it may be renewed upon payment of a renewal fee of 1s. A very important and necessary proviso is made, namely, that the license may be cancelled in the event of the holder doing defective or inferior work. We believe that some time ago the Electrical Contractors' Association discussed this matter, and there was some talk of establishing a system of registration and examination of candidates. We are not aware that any practical system has yet been worked out, but from the evidence which comes before us from time to time there is no doubt that there is a need for some such system.

Car Wheels.

Some little time ago we dealt with the relative position of steel-tired and cast-iron wheels, as we saw it from a position quite outside the reach of makers' bias. At that time cast-iron wheels were cheaper than their rivals, not only in first cost, but throughout their lives, and, in view of a decided tendency to run rashly after the more expensive article, we thought it advisable to put up the red flag of caution. But we did not hide from our readers that improvements in the tired wheel were not at all improbable, and that whenever the first cost, which was the one thing in the way, could be reduced sufficiently by cheapening labour, materials or design, the steel-tired wheel would be on a much more favourable competitive footing, and we went so far as to say that when costs became equal—perhaps before—the advantage would be with it.

From what we can hear, that time has either arrived or is not far distant, and we would suggest to those who took our warning and stuck to cast wheels, that further consideration is now necessary.

At the same time, it should be remembered that not the wheels alone are in question in numerous cases. For instance, it is improbable that wheels with such a range of wear as steel tires have can be used on surface contact systems, except perhaps on the G.B. system; but much more important are those cases in which 30 in. wheels are in use now, for it is fairly well understood that steel tired wheels must be not less than 32 in. diameter when new, and better results may be obtained with another inch. That alteration of 2 in. to 3 in. in the wheel may mean a great deal of alteration to other parts of the truck, especially to the brake gear; and it will affect the rating of the motors, so that, however much steel tires may be desired, the co-related considerations must be studied deeply before any decision is made.

Then again, cast-iron wheels have another chance before them if the radial truck is going to fulfil all the promises and vows made by its divers sponsors, for wheels which chipped and wore under rigid trucks may behave better under sub-trucks; but then the same advantage must extend to the steel tire, and that is so, too, when we think of the benefit which the more general adoption of magnetic braking would confer on wheels of any kind.

Looking at the matter broadly, the next few years will see a large proportion of new cars fitted with steel-tired wheels, not any very remarkable supersession of chilled wheels under existing stock, and a greatly increased life for all wheels, owing in part to the spread of knowledge and in part to better conditions, together with a cutting of prices until both classes of wheel are brought down to a point at which they compare equally.

Who is a Working Man?

The question who is a workman in the eye of the law is one which has often been canvassed in courts of justice.

Employers of labour are so often exposed to liability if one of their "workmen" is injured, that the accurate demarcation of the boundary which separates working men from other classes of the community has proved to be a matter of considerable importance.

But it is also of moment in connection with the use of working men's trams and trains. In a case which was tried by the stipendiary magistrate at Cardiff, on May 24th, the question arose whether a coal inspector was a "mechanic, artisan, or daily labourer," and as such entitled to travel on a workman's tram. The defendant was summoned for travelling on a workman's tram. He contended that he came within the definition. It was pointed out that he performed manual labour and that his work had some perils, inasmuch as he had to climb over wagons. He had also to use tools for the purpose of taking samples of coal. The magistrate said that the test was whether the defendant's work was that of a man who labours, or that of a man who exercises skill in his labour. He found that the defendant's work was such that primarily it required skill in its exercise, and he fined the defendant 5s. The magistrate is probably right, but the case appears to be on the border line. It has been held that the guard on a goods train, whose duty is to guard and conduct the train and to marshal the trucks, is not a "labourer" within the meaning of the Employers' and Workmen's Act, 1875. "The duty of a goods guard," said Baron Pollock, "is much the same as that of a passenger guard, namely, to see that the train is properly put together, and to carefully conduct it. It is a duty requiring care, skill and experience, and the labour which it involves is mental rather than physical. No doubt it would occasionally be his duty, where necessary, to assist the porters in the transhipment of goods to or from his train; but that is not enough to make him a person engaged in manual labour."

D

SOME NOTES ON BRAKING DEVICES.

By ARTHUR W. JONES, A.M.I.E.E.

The recent controversy, which these notes are not intended to re-open, as to the relative essential safety of high efficiency and low efficiency elevator gears, brought into prominent notice the apparent unreliability of the braking devices used by advocates of low efficiency gears.

The following notes are put together on the basis of actual working experience with all the types named—the writer having successively gone through one form after another, as lift speeds have increased from 80 or 100 ft. per minute to their present high level in tall buildings.

It was not unnatural to expect that at the outset of its career the electric elevator would be looked upon with something akin to distrust and its safety considered doubtful. This distrust was, no doubt, the outcome of much unsatisfactory experience with previous mechanically driven gears. As an example, in the case of one elevator gear which the writer "converted" many years ago, the old drive was by belt, and the brake was of the ordinary band type operated by a wedge on the striking gear shaft, which, in turn, was actuated by the hand rope passing through the car. It is hardly possible to imagine anything more primitive; and as no particular care was taken in these early elevators to secure even an approximately correct counterbalance, it was no surprise to be told that occasionally when a belt broke the cage went to the bottom with a rush, and gave the lift operator an opportunity of exercising his agility by jumping before the bump came, at which exercise he was necessarily expert. It may be contended that the brake was still available from the hand rope, but anyone who has had experience of hand rope control will know the difficulty of finding the "off" position, with the cage travelling beyond a comparatively slow speed.

This type of brake is still in use to some extent by makers of the self-sustaining type of gear, and is no doubt good enough if the possibility of accident to the gear itself is not considered, but should this happen, a smash up would probably result, as the braking power available is usually very small.

One of the earliest types of electro-magnetic brake is that shown in fig. 1. This is an adaptation of the ordinary

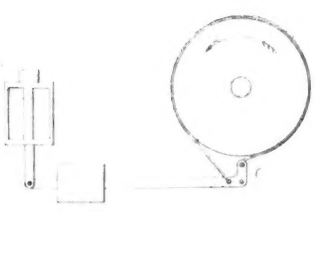


Fig. 1.

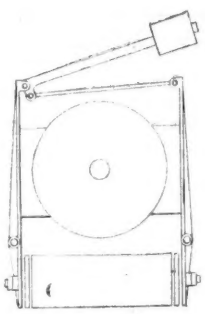


Fig. 2.

hand or foot operated band brake, and as a good leverage can be obtained, the magnet or solenoid can be fairly small with a correspondingly small current consumption. This type is frequently made with a contrivance for putting resistance in series with the operating coil at the end of the stroke, and thus reducing the exciting current after the lever is drawn up. This type of brake is obviously most effective when the motor is running in the direction indicated by the arrow, and it is consequently not altogether suitable for use with reversing motors. A more serious disadvantage is that beyond comparatively small sizes, the band has a tendency to become "sloppy," and will not entirely clear the drum. No matter how carefully the band may be adjusted, it insists on falling to one side or the other and fouling the drum, with the result that, in the case of a 50-H.P. motor that was in the writer's charge, the brake consumed about 3 H.P. and the drum got blazing hot in a very short time.

The brake shown in fig. 2 is perhaps, with its modifications, the one in most general use. The braking power may consist either of a weighted lever, as shown, or of springs, but in the latter case, preferably of the compression type, as indicated in fig. 3. The brake-releasing magnet has to be of large dimensions owing to its small leverage, but in the brake made by Messrs. Laurence, Scott & Co. this

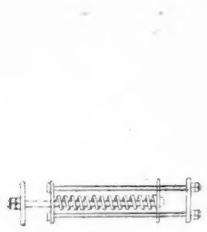


Fig. 3.

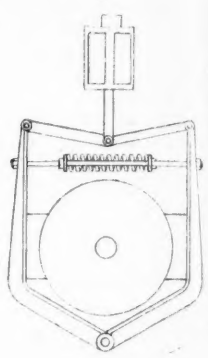


Fig. 4.

independent magnet is dispensed with, and the stray field of a specially constructed motor is utilised for operating the brake release. A slight disadvantage of the brake shown in fig. 2 is that as the blocks wear the armature needs frequent readjustment.

A modification of this brake is shown in fig. 4, and yet another variation in fig. 5. It will be noticed that this latter brake is of the band variety, with wood blocks. A large braking surface was obtained, but this type was eventually abandoned owing to the difficulty of making adjustment for the wear of the blocks.

Fig. 6 shows a brake of an entirely different character to any of the foregoing. It consists of a flange of large diameter keyed to the free end of a motor shaft. The braking power is provided by means of a stationary disk forced against this by spring pressure, and released by a magnet bolted to the motor bedplate. The braking disk is faced with leather. One of these brakes on an elevator gear

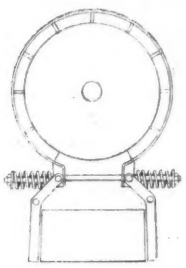


Fig. 5.

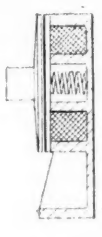


Fig. 6.

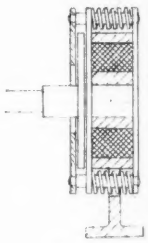


Fig. 7.

has been under the writer's observation for a number of years. It is giving satisfaction, but it has the disadvantage of throwing a heavy thrust upon the motor bearings, which bearings must not, of course, be of the self-aligning type.

Most readers will be aware that on up-to-date self-propelled vehicles the brakes are almost exclusively of the metal-to-metal type, and recently an electro-magnetic elevator brake has been designed to work on this principle. As will be seen from fig. 7, this has somewhat the same appearance as the one shown in fig. 6; but in addition to the leather face being done away with, pressure is put on *both* sides of the revolving flange, obviating all end thrust. The surfaces being of metal and perfectly true, only the smallest clearance —about $\frac{1}{32}$ in.—is necessary, and the brake consequently operates with great promptness. It will be obvious that in this brake the revolving flange and outer braking disk must be of a non-magnetic metal. Care must be taken not to allow oil upon the braking surfaces, as this much impairs its efficiency. A further improvement on the above

brake which would give a greater braking surface, would be to use an increased number of disks, both stationary and revolving. This would not necessarily mean that a greater clearance space would be required.

As previously mentioned, the writer has had all of the above brakes through his hands, most of them on elevator gears, and has not known any one of them to fail. A coil may burn out, certainly, but as this merely allows the brake to come into operation, no danger to life need be feared from this cause. Another possibility is that should the load, and consequently the speed, be excessive, the attendant may lose his head and forget to switch off, but even this trouble may be modified if a governor, driven from the motor shaft, is placed in the brake circuit. This would come into action should the speed exceed a predetermined limit. In one case within the writer's knowledge, a 1-ton lift was loaded by the attendant to 3½ *tons*. The material was sheet-iron, and consequently the bulk was not great. A governor was in circuit, and the action of this and the brake never allowed the cage to exceed the speed limit for more than a few moments at a time, and it was stopped within a few inches of the intended landing. This hoist, by the way, was a wormed-geared one. One wonders how many more so-called self-sustaining hoists are really irreversible. It is outside the scope of this short article to deal with troubles other than braking ones, but it is the writer's experience that properly designed and applied, even under the hardest service and the worst conditions, the electro-magnetic brake is as reliable, and gives as little trouble, as any other piece of electrical apparatus.

RAPID METHODS FOR PRODUCING ELECTROTYPES.

By SHERARD COWPER-COLES.

Introduction.

The practical art of electrotyping is commonly credited as having originated with Spencer, who made experiments on the electro-deposition of copper in the year 1837, but Prof. Jacobi, of St. Petersburg, and Mr. C. T. Jordan, of London, made announcements at about the same time of their independent discovery of the art of electrotyping. The rival

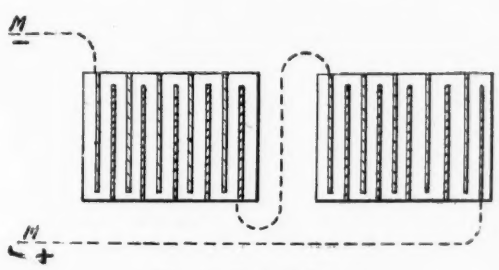


Fig. 1.—Vats in Series.

claims of Prof. Jacobi and Mr. Spencer were brought before the Chemical Section of the British Association, who eventually decided that both had independently arrived at the same result, but that the priority of the discovery was undoubtedly Mr. Spencer's. Mr. T. W. Wilcox, of New York, was the first to make electrotypes from wood engravings in America in 1847, ten years later than the Jacobi and Jordan discoveries. Messrs. Elkington, a little later, applied the process extensively to the reproduction of works of art.

In the early days of electrotyping, the current density employed was only a few amperes per square foot. This was gradually increased to about 20, and in recent years has been increased to 200 or 300 amperes, and even more, per square foot. This has been rendered possible by the use of special apparatus, which will be described hereafter. It has been stated that 75 amperes per sq. ft. is about the limit of practical operations, but it will be shown that these figures can be largely exceeded with economy and efficiency. It is of great value, in many branches of electrotyping, to be able to produce a copper shell in a few minutes, so that electros may be finished and returned the same day. In some electrotyping shops it is customary to have some

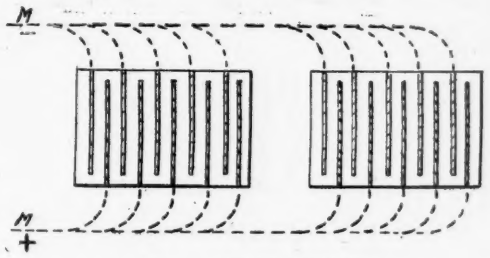


Fig. 2.—Vats in Parallel.

tanks fitted for operating the slow process, and a tank or tanks fitted with special apparatus for quick or rush work. The usual time occupied is from 12 to 15 hours, according to the size of the mould, the thickness varying with the size;

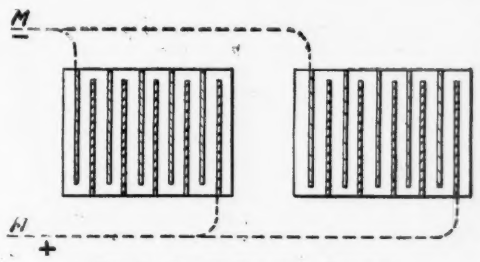


Fig. 3.—Series-Parallel System.

for small blocks a thickness of about ·025 in. (634 mm.) is found sufficient, for larger blocks the usual thickness is ·03 in. (·769 mm.). The electrolyte mostly employed is

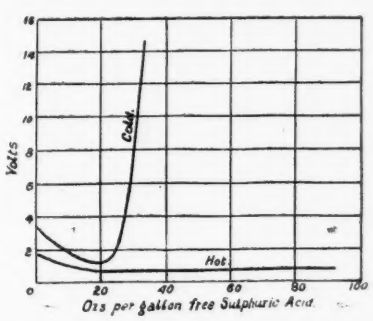


Fig. 4.—Voltage Diagram.

composed of 1½ lb. (680 grms.) copper sulphate, and ½ lb. (226·8 grms.) of commercial sulphuric acid to 1 gallon of water (4·54 litres), the copper being deposited at a current

Fig. 5.—Suspension Hook for Anodes.

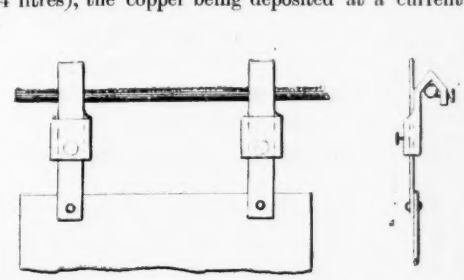


Fig. 6.—Suspension Strips for Anodes.

density of about 10 amperes per sq. ft. (1·1 amperes per square decimetre).

The quick reproduction of printing blocks is of the utmost importance for some classes of press work; in Brussels it is the custom to charge for the work according

to the speed with which it is wanted. The success of the *Daily Mirror* was achieved by converting it into an illustrated paper, requiring a rapid method for the production of printing blocks to illustrate the events of the day. The

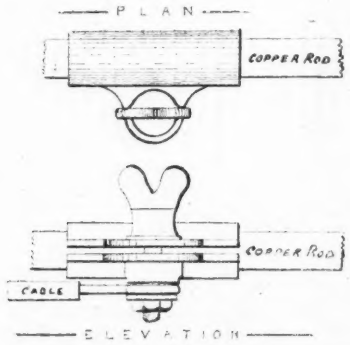


Fig. 7.—Connector for Suspension Rods.

circulation at one time was only 24,000, involving a loss of £100,000, but the circulation was increased to 300,000 when converted into a ½d. pictorial paper. A record half-tone block was made by the *Daily Mirror*, 3 × 3 in., in 23 minutes, and blocks are often made and at work in the printing machines within four hours of the event.

Electrotyping is largely used for reproducing type for economising time in printing by duplicating, and effects a considerable saving in capital, which would otherwise be locked up in standing type. It also effects

Fig. 8.—Section of Elliptical Anode.

a great saving on the wear and tear of the type. Some printing offices have made it a rule never to allow any forme of type to go on the machines; everything must be electrotyped. Again, when standing matter is required, it is much easier and cheaper to store electrotypes.

Stereotyping does not give such a good impression as a good electrotype, as the surface does not take the ink so well, and

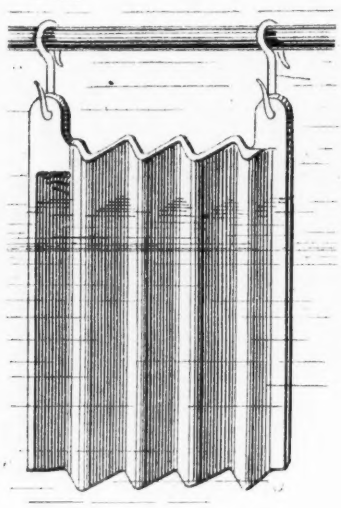


Fig. 9.—Corrugated Anode.

its sharpness soon wears off on the hard surface of many papers.

Series and Parallel System.—In America it is the usual custom to work the vats in series (see fig. 1); in this country they are usually worked in parallel (see fig. 2)—that is to say, the electric current from the dynamo is distributed to the different vats by a common conductor, the amount of current flowing to each vat being regulated by suitable resistances. When the vats are worked in series, the electric current passes through one vat into another vat, in which case it is necessary to have approximately the same area of moulds in each vat. If the dynamo gives 1,000 amperes, and supposing there are two baths worked in parallel, the amount will be divided between them in proportion to the surface to be deposited on, whilst in the latter case, if the same two vats are used 1,000 amperes will be passed through each vat. The voltage

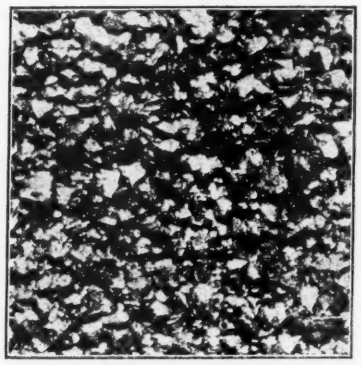


Fig. 10.—Crystalline Deposit.

required for the series system is nearly double, but, on the other hand, the weight of copper is also double. The series system, from a power point of view, is more economical than the parallel system. There is no practical difficulty in working the series system; the only precaution that has to be taken is to keep the surface of the cases to be deposited on of approximately the same area in each vat.

A third system consists of the series-parallel system (see fig. 3) that is, the electrodes are worked in series, and the baths in parallel. The disadvantage of such a system is that if all the cathodes are removed from one suspension bar, the electric current is entirely stopped.

Composition of Electrolyte and Method of Rectifying Same.—The composition commonly employed is a 22 per cent.

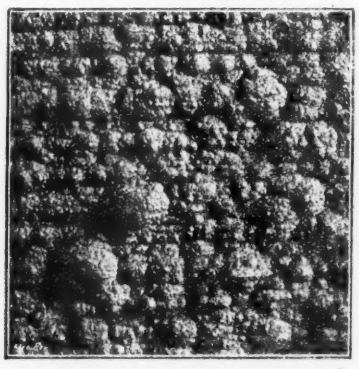


Fig. 11.—Nodules Formed on Stationary Cathode.

copper sulphate solution, containing about 18 per cent. blue stone, and 4 per cent. of acid, or made up from a saturated solution of copper sulphate; to each gallon of saturated solution is added a quart of water, and finally 4 oz. of sulphuric acid. When the solution is agitated, it is found that a higher percentage of acid can be used than would otherwise be the case. It is important that the electrotype should be kept in the best working condition, that is, the relative percentage of copper in solution to the percentage of free acid. There are several rough and ready means of rectifying the solution, such as taking out a known quantity of solution in a stone jar, and adding a known quantity of acid, and then testing it by depositing a shell in the jar at

the usual current density. If good results are obtained, then the same quantity of acid is added to the solution. If the solution is too strong in acid and copper sulphate, it will be observed that small crystals form if left to stand in a glass vessel; if this is the case water should be added. If the copper is deposited in a sandy form, it indicates too strong a current or too much free acid.

It is found in practice that the anode dissolves faster than the metal is deposited, even when high current densities are employed, therefore the anode area should be less than the cathode area.

The resistance of the electrolyte is dependent on its composition, that is, the amount of free acid as compared with the amount of copper sulphate, also on the temperature. Care must be taken that the solution

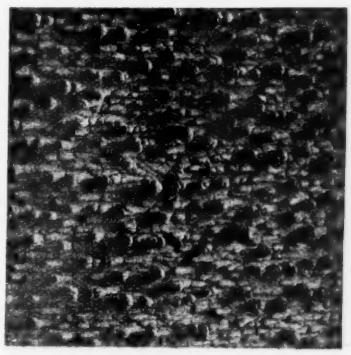


Fig. 12.—Nodules Formed on Revolving Cathode.

is not supersaturated, otherwise small crystals of copper sulphate will form on the anodes, and greatly increase the resistance.

The resistance of the electrolyte is largely dependent on the temperature; the higher the temperature, the lower the resistance, see diagram, fig. 4, therefore it is advisable, where possible, to work with metal moulds, in which case the temperature can be raised to 150° or 200° F; when wax moulds are employed the temperature of the electrolyte cannot be raised above 80° F.

Hard bright deposits of copper may be obtained by Sir Wilson Swan's method as follows:—4 or 5 per cent. solution of good gelatine is treated with two or three drops of strong

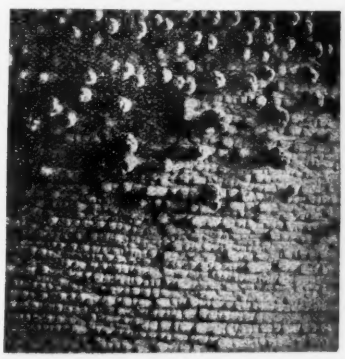


Fig. 13.—Nodules Formed on Revolving Cathode.

nitric acid per 100 cc. on a water bath, till it loses its gelatinous properties. Five or more cc. of this solution are added to one litre of ordinary electrotyper's solution (acid sulphate of copper). A current of 150 amperes per square foot is found to give good results, and the current should be interrupted every 10 or 15 seconds for a similar period, otherwise the copper comes down in a loose non-adherent form; the space between the electrodes must be vigorously stirred; in this way most brilliant deposits can be obtained. It is the practice in some shops to deposit a thin film of copper by such a process, so as to get a hard printing surface, and thicken up by the ordinary methods.

Anodes.—The copper used for anodes for electrotyping purposes should be as pure as possible, to prevent the contamination of the electrolyte; the introduction of a small quantity of tin is not found to be detrimental, but is recommended by some authorities. The anodes should be suspended by strong copper hooks; a good form of hook is

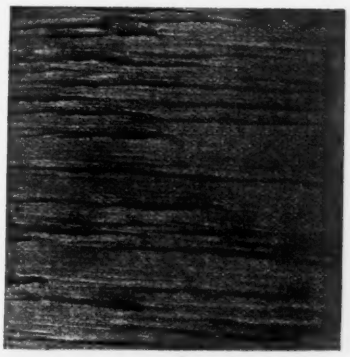


Fig. 14.—Wave Lines Formed on Revolving Cathode.

shown in fig. 5. The section should be square, so as to have as large a contact surface as possible; the loop is for the purpose of lifting the hooks and the cases from the suspension rod.

Fig. 6 shows a form of suspension hook for the anodes, so that the height of the anode in the electrolyte can be readily varied from time to time, otherwise the suspension strips or hooks are eaten through on the air and water line by the electrolyte. Fig. 7 shows a useful form of terminal for attaching the flexible cable to the suspension rods.

Elliptical anodes are now being used, of a section shown in fig. 8, about 2 in. × 1½ in., the strip of copper to form the hook being cast into the head of the rod. It is claimed

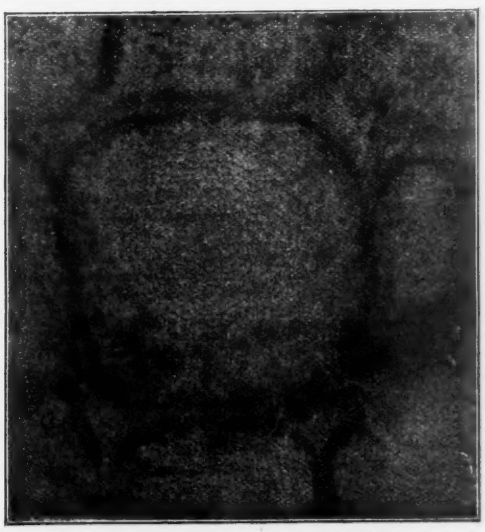


Fig. 15.—Copper Deposited by Impingement Process.

that they can be hung as much as 4 in. apart, without any difference in the uniform thickness of deposit being noticed. The advantages are that they can be readily adjusted to suit any size plate, or even curved surfaces, that they permit of a better flow of the electrolyte when agitated, that they are easy to clean, and that they form less scrap. They are sold at a little above the market price of rolled copper.

Another form of anode, which can be cast or rolled, is shown in fig. 9. This anode is suitable for certain classes of apparatus used for rapid electrotyping, as it prevents the solution being whirled round with the revolving cathode.

Nature of Copper Deposited.—The nature of the copper deposited is dependent on the composition of the electrolyte, the current density, and the method employed for circulating the solution. If too high a current density is used, the

copper comes down in a loose powder; if too low, it is liable to be very crystalline, such as shown in fig. 10.

If the solution has much matter in suspension, small specks of dirt will settle on the surface of the deposited metal, and nodules will be formed as shown in fig. 11. Figs. 12, 13 and 14 show various forms of copper deposited on rotating cathodes, and indicate too great a current density for the speed employed. If the solution is impinged on the cathode, there is a tendency for the copper to be deposited in a form such as shown in fig. 15.

(*To be continued.*)

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Maver's Wireless Telegraphy.

Permit me to acknowledge with thanks the receipt of a marked copy of your esteemed journal, containing a review of my humble production, "Maver's Wireless Telegraphy."

The spirit of the review is very kindly, a fact which I fully appreciate. Some of the criticisms, however, I imagine, are not altogether well taken, as, if permission be granted, I shall endeavour to show.

For example, the reviewer says: "In alluding to the methods of wireless telegraphy by induction and spreading of currents, however, the author has omitted any reference to what is, no doubt, the most remarkable of these earlier methods—viz., the system of wireless telephony, of which some use is still made in this country by the Post Office. Possibly the author has never heard of it, though it accomplishes the clear transmission of speech over some 3 or 4 miles of sea." Without further comment on this point, allow me to quote from the book, p. 12: "More recently the same experimenter (Preece) has succeeded in establishing a wireless telephone circuit by means of which speech is transmitted between the Skerries lightship and the mainland of Anglesey, a distance of nearly 3 miles, the parallel wire on the Skerries Islands being 750 yards in length, and that on the mainland 3·5 miles in length, the ends of each wire terminating in the sea, &c."

The reviewer also remarks that the book "contains no reference to the coupling question, which has assumed such importance in this country." It is true that the book contains no mention of the term "coupling," that term being a comparatively recent addition to the nomenclature of the art. But while there is no reference to "coupled" circuits in the work, there are many references to open and closed circuits, and numerous instances of loose and close couplings are given, and the advantages of coupling are more than once mentioned. Thus, p. 92, it is said, "There is thus here the closed oscillating circuit to produce persistent high-frequency oscillations combined with the open circuit consisting of K and the aerial wire which is a powerful radiator, and which thus strongly radiates the (said) persistent oscillations." The coupled systems of Braun, Lodge, Marconi, Shoemaker and Stone are also described. Of course, in view of the rapid progress of the art in this and other respects, there is, as the reviewer intimates, now room for the addition of considerable information.

The reviewer's statement that the book contains a description of a number of "paper" systems, is not thought to be quite fair to the systems described, inasmuch as, with, perhaps, one exception, all the wireless telegraph systems described in the work are either in actual or experimental operation on a large scale, virtually as described therein.

The Author.

An apology is due to the author of the book in question. By some unaccountable mistake—possibly the notes referring to another production had got mixed—it was assumed that no mention of the Skerries wireless telephone had been included in the work.

As regards "coupled" circuits, there are couplings and couplings; but the important aspect of this question is in its relation to tuning and selective transmission, and it is rather in the theory and practice of adjusting the degree of coupling that the importance lies. In the coupled systems referred to in the book, there is not necessarily any marked development in this respect.

On the third point the reviewer ventures to hold to the opinion expressed. In more than one case, descriptions of practical or experimental results have been published, which have assuredly had a better foundation in the experimentalist's imagination than in fact.

The Reviewer.

The Single-Phase Induction Motor.

I have certainly not forgotten what this correspondence was all about; but, judging by his letter, Mr. Creedy apparently has, for he now confuses the issues, and says that I have so far failed to point out why the equations he gave in his letter of March 27th, were incorrect or inapplicable, and why the two diagrams (1 and 2) I showed in mine of March 31st were not identical. In my last-mentioned letter I have, contrary to Mr. Creedy's assertion, dealt very fully with these points, and have conclusively justified my view of the two points then in dispute—*i.e.*, that E S in the armature axis of the rotor does not vanish at synchronism or at any other speed, and that the phase of the motor field, and, therefore, the phase of the back E.M.F. (E B) is not opposite to E T. I can see that Mr. Creedy is now prepared to accept these views; but instead of saying this plainly, he playfully suggests that I have "inadvertently" given the same name E B to two distinct E.M.F.'s in my figs. 1 and 2. Mr. Creedy is unfortunate even when trying to pay me a compliment; after condescending to say that my fig. 2 is a great advance on fig. 31 of my I.E.E. paper, he puts this down to my acceptance of some important action to which he drew attention. I have just been forced to again remind him that I had totally refuted, and not accepted, his suggestions, and I may add that fig. 31 of my I.E.E. paper has nothing to do with the fig. 2 to which he refers, they illustrate totally different points—a fact of which Mr. Creedy must surely be aware—and consequently the one cannot possibly be an improvement on the other.

I cannot say that I appreciate the manner in which Mr. Creedy conducts his case, and I am consequently not inclined to spend time in further discussing the matter with him, or in going over old ground, just because Mr. Creedy chooses to forget what has already been said. But since I am now answering his last letter, I might as well say that I do not quite see what Mr. Creedy has proved with the help of all his formulæ. He comes to the conclusion that at no load his rotor current in the armature axis is equal and opposed to the stator magnetising current in that axis, and from this he deduces that the primary current *must* at no load be double the stator magnetising current! Now Mr. Creedy wishes to prove (see his letter March 27th) that "a motor entirely devoid of losses and leakages will take at no load a current equal to twice the magnetising current." But such a motor can only take wattless current, since it does no work and since there are no internal losses to cover. Remembering this, it is easy to see that an equally correct way of interpreting $i_1 = -i_0$ (for I presume $i_1 = -i$ to be a misprint) consists in saying that since the motor can only take wattless current, and since the wattless or magnetising component (i_0) of the stator current is, according to Mr. Creedy, equalled and opposed by a rotor current (i_1) in the armature or transformer axis, then whatever the magnitude of this wattless current it will always be neutralised, with the result that there will be no transformer field and . . . . no induction motor. We must also consider that if i_0 is to be equalled and opposed by i_1, the latter must lag 90° behind E T; this can only be the case if $r_2 = 0$, and if E S has a value different from zero. By hypothesis r_2 is zero, but according to the reiterated assertion of Mr. Creedy, E S vanishes at synchronism; it follows, amongst other things, that whatever the value of i_1 at that speed, it must be in phase with E T, and therefore cannot oppose i_0. For the special conditions under consideration, i_1 is really zero, but a current i_2 does flow through the rotor along the axis D D; in

magnitude it equals i_0 (assuming the number and the disposition of turns on stator and rotor to be equal), and in phase it leads i_0 by 90°. If energy is required to produce i_2, then i_1 will be different from zero, but the losses in the motor are supposed to be nil, so that no such energy will be required.

I have always been led to believe that a generator which works on a purely inductive load and, therefore, only gives out a current lagging by 90° behind its E.M.F., does not absorb more power than is required to cover its own internal losses. I also see no reason why the exciting current of a separately excited alternate current generator should vary of its own accord with the magnitude and the nature of the load on that generator. These two simple beliefs will have to be upset before I can recognise that the no-load current of a single-phase shunt induction motor devoid of all losses must be more than just the magnetising current required for its transformer field.

In concluding this correspondence as far as I am concerned, I should like to add that I am glad to hear that Mr. Creedy's remarks in his of March 27th were not intended to be personal; he is, however, in error if he thinks that they hurt me.

Val. A. Fynn.

London, S.E., *June 9th*, 1906.

I have been reading with pleasure Mr. Fynn's interesting paper on his new induction motor, and the discussion which followed it. Referring in particular to the discussion, Fynn-Creedy, about the value of the no-load current, I should like to express my opinion on the subject. I think that both Mr. Fynn and Mr. Creedy are right in their assumptions, if the first refers to the induction motor with commutator and brushes short-circuited at 90 electrical degress, and the second to the ordinary single-phase induction motor without commutator. These two types of machines are essentially different in their behaviour, as will be seen from the following principal characteristics:—

In a machine of the first type and without losses, the no-load current is equal to the magnetising current, while in a machine of the second type the no-load current is nearly double the magnetising current.*

The no-load current may be considerably increased in a motor of the first type by the friction losses, and the resistance along the motor axis.

This resistance has the effect of producing a difference of phase between the E.M.F. E R generated in the transformer axis by the motor flux, and the E.M.F. E T impressed by transformer action.

In consequence of that there will be, even at synchronism, a resulting E.M.F., which, by producing a secondary current in the transformer axis, increases the no-load current.

In an induction motor with commutator, unlike the other type, the resistance of the armature along the transformer axis plays a vital part in the production of mechanical work.

The power factor in this type of motor will rise steadily with the load, and will reach its maximum value when the motor is standing still, that is, when it has become a simple transformer. In this case the input of the machine reaches its maximum value.

It is well known that, in an ordinary induction motor, the power factor rises with the load, reaches a maximum and as a rule, falls to a lower value before the machine goes out of step. At standstill, in a well-designed machine, the power factor should be very low.

Referring now to Mr. Creedy's last letter, it is easy to prove the incorrectness of his deductions by introducing the conditions $r_2 = 0$, $x_1 = 0$, in his fundamental equation (1) and deriving the following obviously inacceptable property:—

"In a machine without secondary leakage and resistance, when not running at synchronism, the magnetising current is *nil*."

N. Pensabene-Perez.

Witton, *June 12th*, 1906.

* See Behrend "The Induction Motor," where the complete theory of the single-phase induction motor can be found treated in a masterly way with an elegant synthetical method.

Neutralised Repulsion Motor.

Owing to a mistake on the newsagent's part I have only just seen your issue of June 1st containing Mr. Fynn's letter.

I understand Mr. Fynn's position to be that, any recognised authority notwithstanding, he requires me to give a full, perfect, and sufficient exposition, theoretical and practical, of the suggested motor for his special benefit. The demand is unreasonably large; but I will not refuse. I will try and find time to do it during the next few weeks.

William Cramp.

Colwyn Bay, *June 11th*, 1906.

Flame Lamps.

It has been apparent from the different articles which have been published on the subject, and the recent discussions at the Institution, that the flame lamp has come to the rescue of electric lighting, when it was needed in order to compete with the high-pressure gas systems which are making so much headway. Any advance, therefore, in flame lamps, will be a nail in the coffin of gas, and will be received with satisfaction by the trade.

As might have been expected, the Jandus Co. finding the flame lamp under certain conditions, a competitor to their well known enclosed type lamps, have been endeavouring for some time past to go one better as regards simplicity and reliability of mechanism, a feature which has hitherto interfered with the progress of the flame arc lamp.

It appeared to them that lamps in which the carbons were fed by gravity and supported by a stop, offered the best solution of the problem, if a suitable stop could be found which was reliable and inexpensive. Previous attempts with platinum, iridium and other costly materials, had only met with partial success, but the Jandus lamps which are now being put on the market claim to have overcome this difficult problem by an entirely satisfactory method and at small cost.

Patents had been applied for, and the company are making special arrangements for the large demand which they anticipate as soon as the simplicity and cheapness of their new lamp is made known.

The lamps run three in series on 200 volts and one special feature is that they regulate without shunt coils of any kind; they have no make or break contacts, screws, or any of the paraphernalia adopted in the early patterns of arc lamps.

Drake & Gorham, Ltd.

Westminster, S.W., *June 9th*, 1906.

Flexible Wires.

We are pleased to see that you have opened your columns to the discussion of the dangers attending the use of cheap and badly-constructed lamp flexible. The large quantities of "cheap and nasty" material now in the market, make the present a most opportune time for a full and close examination as to what *is* the most suitable and safe flexible to use where good sound work is desired. Your earlier correspondents suggest that the stranded conductor is at fault. The root evil of present-day flexible does not exist, to our mind, in the stranded conductors, but rather in the coverings that are applied to those conductors.

The class of flexible that is most largely used at the present time is a flexible constructed of plain copper wires, covered with a single lapping of cotton and one coating of vulcanised india-rubber. The British-made article, generally speaking, is manufactured with a genuine vulcanised rubber of a quality which varies in direct proportion to the cost price. Unfortunately, however, the bulk of this cheap material is drawn from abroad. The so-called V.I.R., consists of the smallest possible percentage of rubber loaded to the utmost extent with undesirable mineral matter. It is squirted on to the conductor through a die in a form resembling putty, being plastic whilst new, but after being in use for a time becomes hard and cracks. We have seen flexible, the insulation of which after 12 months' storage has gone to a powder that you could shake through the outside braided covering. These characteristics have been illustrated over and over again in our experience, by samples taken from fittings in various

parts of the country. Most of the trouble arising from time to time with these flexible cords can be traced to this cheap foreign material. Another fault in its construction, and one that is shared by the British-made article, is the very scanty precautions adopted in this particular class of flexible against the chemical action of the V.I.R. on the copper, the process of vulcanisation having a great tendency to make the very fine copper wires brittle.

The present vogue of this class of flexible is due principally to two reasons.

1. The present day excessive cutting of prices.

2. The makers of fittings during the last few years have so designed their apparatus that high-class V.I.R. flexible is, generally speaking, found to be too large for wiring the necessary fittings.

Now the cost of flexible is such a small percentage on the total cost of an installation, that there is absolutely no excuse whatever for the use of cheap, poorly constructed flexible; and we are glad to see that station engineers all over the country are gradually exercising a most beneficial influence by insisting that a high quality flexible shall be used in all installations connected to their mains.

The most suitable flexible to adopt is, in our opinion, that specified by the Institution of Electrical Engineers in the following terms :—

> The insulating material used as the dielectric should be two laps of pure rubber, care being taken that these lap joint. The radial thickness of the dielectric should never be less than 16 mils, for pressures up to 125 or 20 mils for pressures up to 250 volts. (Page 5, I.E.E. Wiring Rules.)

The use of pure rubber for the insulation of flexible cords has many great advantages, the most important being the absence of any chemical action on the wire, the much greater flexibility obtained, and the very high degree of insulation secured for a minimum thickness; this latter advantage obviating the difficulty that has hitherto existed of wiring fittings with a high-class flexible. We are glad to say that these advantages are being increasingly recognised.

Where vulcanised rubber is insisted upon, or rendered necessary by use in very wet situations, the flexible should be constructed of tinned copper wires insulated with a coating of pure rubber to protect the copper, and then with two coverings of V.I.R. To meet this want of a high-class V.I.R. flexible of uniform standard quality, a flexible has been specially designed and registered under a trade mark by the Cable Makers' Association.

The fullest security against fire risks in electrical wiring is of the utmost importance both to the public and to electrical engineers. We feel this can only be obtained by consulting engineers, architects and insurance offices insisting upon the use of standard high-class grades; and if your interest, sir, in this subject succeeds in arousing strenuous opposition to the use of cheap and dangerous flexible, you will have earned once more the hearty thanks of the electrical trade.

We must apologise for intruding so largely upon your space, but the inadequate recognition of the importance of this subject hitherto must be our excuse for troubling you to this extent.

The London Electric Wire Co., Ltd.

London, E.C., *June 6th*, 1906.

Musical Jointers.

I read with interest, but not much amusement, a letter under this heading by "Witteystubb" in the ELECTRICAL REVIEW of to-day's date. On referring to the advertisement mentioned by your correspondent, I found that, contrary to the impression given me, a mere preference was expressed for a musical man. I certainly cannot imagine any sane person supposing that superior musicianship could in any way compensate for deficiency in professional skill.

Again, to use the language of the late engineer of an eastern suburb to one of his councillors, "Witteystub" is getting involved in musical technicalities with which he is surely not familiar. A knowledge of the fundamental rules of harmony which he quotes is no guarantee that a man is a musician, while a skilful performance on the jew's harp might indicate some latent talent of which great things would come if the opportunity were given.

It would also be interesting to know if "Witteystubb" ever heard of a jointer in the course of his professional duties being required to unite any substances for the passage of an electric current other than those whose oxides exhibit basic properties.

In view of "Witteystubb's" letter, one may expect that the musical publishers will have numerous applications for examination text-books from electrical engineers in the near future, and we may hope, for the sake of his musical knowledge, that among the largest orders will be that of your correspondent.

Neither Mus. Bac. nor F.R.C.O.

June 8th, 1906.

Street Lighting.

We have read Mr. Turnbull's article with great interest, and we shall certainly not fail to profit by his remarks. As far as the delay in the delivery of the new AD Nernst burner is concerned, we quite agree that it may look unbusinesslike, but we can assure your readers, that it was entirely unavoidable. The new AD Nernst burner is such an improvement on the old type that we would not delay, even for a day, its being put on the market, if we could possibly help it.

As regards lanterns, we sell two types: the "Perfecta" and the "Royal." Both are used in large numbers and with great success for street lighting. In the "Perfecta" fitting the reflector is part of the lantern, whilst the "Royal" can be supplied either as shown or with slanting reflector or without reflector.

THE "ROYAL."

THE "PERFECTA."

FITTINGS FOR NERNST LAMPS TYPE AD.

Our holophane globes type H3 fit both lanterns.

A.E.G. English Manufacturing Co., Ltd.
C. PFEFFER, *Manager.*

London, W.C.,
June 11th, 1906.

When I had scanned Mr. Turnbull's brief article on the above subject, which you published in your last issue, and came to the sentence, "May one hope that some discussion

on the question may awaken our friends, the manufacturers, so that they may produce fittings more worthy of the traditions of the electrical industry," I went to sleep and dreamed an awful dream about the traditions of the electrical industry, which I had disgraced in some terrible way by designing "fittings which utterly fail to come up to common-sense requirements, and refusing to listen to criticism." Then I woke with a start, wondering how it was I was allowed to live—or, at any rate, to make a living, and half hoping I might be able to get a job as municipal electrical engineer to some quiet country station, where the committee would keep me from ever doing such wicked things again.

But on reading Mr. Turnbull's article carefully, I felt better: in fact, nearly well enough to go to sleep again. But before doing so, my conscience told me I ought to write and remind Mr. Turnbull of certain simple little laws, the existence of which should be borne in mind when designing reflectors, &c.

One of these laws is that the efficiency of a white reflector is nearly proportional to the cosine of the angle of reflection, therefore "the ordinary designer of reflectors," in sending the light back through its source, is using the reflector at its maximum efficiency, whereas the fittings which Mr. Turnbull states "would give the maximum possible illumination in the street" actually would not increase it perceptibly. The reflectors which he illustrates in fig. 1 are what are commonly called "eye-deceivers." They hardly alter the distribution of the light, but have the advantage of the illuminated white surfaces giving the appearance of a larger source of light.

As regards globes, I would remind Mr. Turnbull that there is another little fact which he has forgotten, namely, that the absorption of light is in proportion to the ratio of the superficial area and quantity of glass. And, as the superficial area of a sphere increases much more rapidly than the quantity of glass required, the larger globes absorb less light than the small ones.

As regards grasping the "vital points" of the design of lanterns. Mr. Turnbull is right in saying that the question of cleaning is very important. Therefore, those lanterns which are dirt-proof, and require practically no internal cleaning, except when lamps are renewed, are no doubt the best. The liability to sweat is quite done away with if they are properly sealed.

Mr. Turnbull's remarks concerning Nernst lamps are very interesting; but that the lighting of smaller streets *must* be done with them is, of course, only a matter of opinion. Nevertheless, I trust his remarks will come to the notice of the Allgemeine Elektricitats Gesellschaft, and that they will "listen to criticism," "awaken," and "produce something more worthy of the traditions of the electrical industry."

Dulciter Dormans.

Separation of Oil from Feed Water.

It has occurred to me that some of your readers may be troubled with oil in their boilers, and a little experience we have had in the matter may possibly save them some considerable trouble and annoyance.

The plant here is surface condensing, and we have some filters which took the grease out of the feed water by mechanical means. This system worked admirably until we started some new boilers and steam pipe. We then found, though we were using less cylinder oil than formally, that the oil was not extracted by the filters in the same efficient manner as it was before the new boilers were started.

After very careful investigation, it was discovered that there was a considerable amount of oxide of iron in the steam being brought off from the new boilers and steam pipe.

Further experiments showed that when a very small percentage of oxide of iron is contained in the water, viz., in this case, the discharge from the air-pump, that the oil cannot be separated from the water by mechanical means; hence we were obliged to adopt a chemical purifier.

If an economiser is used we find that a great deal of the oil can be kept out of the boilers by attaching an atmospheric pipe to the feed pump range, heating up the economiser, keeping the feed pump working, shutting the valves to the boilers, and opening the valve to the atmosphere; the water will then boil, of course, at a tremendous rate, cleansing the top of the boxes of the economiser, and driving out to the atmosphere a great deal of grease which otherwise would reach the boilers.

With regard to the chemical purifier, I can only say that the analysis which we have had of the water proves that it takes out every atom of oil, and there is no oil whatever contained in the water now being sent to the boilers.

I would apologise for mentioning this matter, but I hope that possibly this information may be of service to some of your readers.

Joseph A. Jeckell,
Manager.

Coventry Electricity Works.
June 12th, 1906.

The Real Efficiency of Boilers.

Remembrance of Mr. W. H. Booth's keenly-pointed controversial pen, under which the writer, then an onlooker, has imagined others to be writhing, has acted for two days as a deterrent on my own poor attempts to tread on the trail of a coat so invitingly trailed before us.

But at the risk of being assailed with quotations from Omar Khayyam, I must protest against the first sentence of the second paragraph. Mr. Booth says: "It is bad engineering to regard the boiler and the furnace as an indivisible whole." In the name of all the efficiencies which Mr. Swinburne has defined, Why?

In most types of boilers, Scotch, Lancashire, or tubular the furnace is surely an integral part of the boiler. As much (or more perhaps) as a receiver between the high and low pressure cylinders of a compound reciprocating engine or as the jackets are parts of the engine. Yet it would be a weird ultra-refinement of testing to work out the efficiency of the engine making no allowance for the heat expended in reheating in a receiver or for condensation from the jackets.

The tendency surely seems to be in the direction of consolidating efficiencies. More and more do we speak and think of steam generating sets as having such and such a consumption per kilowatt-hour. Of course, where we can, it is well to differentiate between the losses in engines and generators. But the overall efficiency is the vital point. So with boilers. Personally, I admire the courageous emphasis which Mr. Booth shows in tackling thermal extravagance. But the ordinary boiler test which regards the furnace as an integral part is as effective as, (if flue gases are analysed, and the sources of loss located), and certainly more suggestive than, a process of fractional distillation and differentiation of efficiencies.

A last question, and this more or less a side issue, although very dubious as to steam calorimeters, I must ask what are we to do where the steam is not dried or superheated, and thermometer checks are impossible?

Thermal Unit.

Electrolysis and Joint Boxes.

In reading the above article in your issue of June 8th, it struck me rather forcibly that to insulate each section of metallic covering on cables would bring about a series of troubles that would hardly compensate for the removal of a *doubtful* electrolytic action. To illustrate clearly what I mean, I give below an example.

Supposing a length of T.C. distributor becomes punctured by a blow from a pick or some corrosive action, and puts the outer conductor of the main to the sheathing, but this sheathing is insulated from all earth connections with the exception of the soil in which it lies, this soil may be such as to so insulate the sheathing, that *no earth is recorded* at the supply station. In time the moisture out of the soil penetrates into the cable, and causes a "dead short." This would probably cause a whole section to be disconnected.

In the case of a single cable, of course this would not happen, but one of the other cables of a different polarity in the neighbouring district may develop a similar fault (especially if the initial trouble is due to some corrosive action), and then would follow a similar disaster.

E

The above dangers are being greatly magnified by the use of leadless cables which some engineers are now advocating, for if a cable has a metallic sheathing, it does tend to form an earth plate in the soil, to give some small indication of a leakage, but without this sheathing there is no possibility of any such indications.

I also note that a remark is made to the effect that the earth bonders on to the joint boxes are not of sufficient area to carry large currents.

Is it necessary for these bonders to carry large currents?

I think not; for if a suitable and adjustable resistance is inserted between the earth conductor and its earth connection a perfect control can be kept over the amount of leakage current; for a fault which will pass a current of 10 to 15 amperes, can be quickly and easily localised: of course, if the mains engineer is not capable of localising a fault until he sees the smoke, and he uses 200 to 300 amperes to produce this smoke, then he must not be surprised if he finds signs of heating due to his bonding being badly done or of insufficient area.

If the above troubles are going to occur, I think it can be safely concluded that to bond your sheathing and make it continuous will be the better way out of the difficulty. Bond the sheathings of all cables together wherever possible; that is, if a service is being connected and a feeder or any other cable passes by, bond all together. A system composed of three single cables for distributors will be in a much more healthy condition to deal with the bonding process than a T.C. system.

A great number of the faults are probably due to the neglect of localising small leakages and neglect of testing the neutral of a three-wire system. This latter neglect may lead to very serious results. The following is what has actually occurred on a three-wire system:—The recording ammeter in the earth circuit showed a leakage current of about ·3 ampere; no one bothered about it. Later a fault developed on one of the outers, a resistance was in the earth circuit which was to keep the leakage current down to about 15 amperes; but the actual leakage on one side of the system was 150 to 200 amperes. This caused a section of the network to be disconnected. After the outer fault had been removed, the ·3 ampere was still recorded. It was then discovered that this small current was due to an earth on the neutral and a difference of potential between the earth at the supply station, and the fault had maintained this small current, and, of course, when the outer went to earth, a "short circuit" was set up.

Test the insulation of the system as frequently as possible, and try and find out the cause of every small leakage which is recorded. The following method keeps a good check on motor consumers who have the frames of their motors earthed. See that the earth wire is brought up to your cut-outs, and is kept insulated from everywhere else; then "earth" it on to your service cable through a small fuse. It is then an easy task to occasionally have these fuses inspected.

Watch and test the mains at every available opportunity. Treat them with respect, and don't neglect them. If you suspect a joint or a disconnecting box, go and look yourself; don't leave it for a jointer.

Watch the "practical possibilities," and not the "theoretical probabilities," and, above all, never put off looking for a fault.

Mains Engineer.

A Grievance.

In the "Situations Vacant" column a week or so back appeared an advertisement for switch hands, &c., put in by a firm some miles from London.

I was a successful applicant, and received letters stating when to start and agreeing to pay me a certain price.

It seems to me that this particular firm makes a practice of offering a price to men and endeavouring to compel them to accept less when down there.

When I arrived to start, I was told they had no vacancy for me at the price they agreed to pay me, and referred me to a different department, which was quite a different work to which I have been used to.

As I have a friend who was served the same trick some time ago, I think it only right in the interests of fellow workmen (who may be taken in by their methods) to mention this as a warning.

In some cases men may travel many miles to start for these people, and be compelled to accede to their terms (which is nothing more or less than a scandalous way of obtaining cheap labour), owing to lack of funds to return to where they came from.

Something should be done to stop this.

Rheostat.

Walthamstow.

Rubber Companies of Ceylon and the Malay States.

Judging from the prices at which certain of these shares are quoted on the Stock Exchange, one would naturally be led to conclude that these companies have a good future. Their capitals are by no means large, so that small returns should mean good dividends. But it must not be forgotten that these companies are exploiting *immature* trees. They are taking from them, not the natural product—such as leaves or fruit—as is the case with tea, coffee, cocoa, &c., but their actual life's blood, the sap. It is a question to be decided only by botanical experts as to whether or not under such unnatural conditions these saplings, for such they are, will resist the weakening effects of such a drain on their constitution, and yet continue to grow and flourish.

It is the opinion of the writer that young trees thus tapped will gradually weaken and fall a prey to some of those fungoid growths which fasten only on the weak, and that, therefore, it may not be unreasonable to expect that we shall soon hear of a rubber tree blight.

Of course, we have never yet heard of such a scourge from the old rubber-producing districts—*e.g.*, the Amazon districts—for the simple reason that the trees there from which the rubber is extracted have long reached maturity, and are, in consequence, well able to withstand the strain of sap extraction. But such is not the case with the baby trees of Ceylon and the Straits Settlements. As the rubber industry has ever been so intimately connected with electrical enterprise, the subject of rubber plantations should fall within the scope of your journal. The views of other of your readers on this subject would be of value.

D.

Brakes and Tramcar Accidents.

Referring to the letters we wrote you recently *re* brakes for electric tramcars, we desire to point out that the car to which the accident happened at Swindon was fitted with electro-magnetic brakes.

Out of the three serious runaway accidents that have occurred during this year, two of the cars involved were equipped with electro-magnetic brakes—viz., at Huddersfield and Swindon, while the third—viz., at Liverpool—was not fitted with the electro-magnetic brake.

Estler Bros.

London, E.C., *June 7th*, 1906.

Inaccurate Electricity Meters.

When a meter is removed from the premises of a consumer to the supply authority's test room and is found inaccurate, what may be done? It is the practice here to add to or deduct from the account, an amount equivalent to the estimated number of units not registered or registered beyond the correct amount. This is done whether the removal has been occasioned by a complaint on the part of the consumer, or by the fact that the account has, in the opinion of the supply authority, become abnormal.

In a case of this kind, besides the state of the meter, the average of previous or subsequent registrations on the same or another (accurate) meter is taken into consideration.

A meter may be stopped for a part or the whole of the period between successive meter readings, the failure to register being due, for example, to a small piece of enamel or dirt falling on to the disk and getting wedged under the brake magnet, so that the meter is quite accurate when the dirt is removed. Is it permissible for the supply authority to make an estimate without testing the meter?

It has been pointed out that there is nothing in the provisional order or in any Act of Parliament which gives the supply authority power to act in this manner: it appears to be necessary to appeal to the electric inspector or to the Board of Trade. But I venture to say that this is scarcely ever done any more than meters are tested by the Board before being used for supply purposes (*vide* Elec. Rev., May 18th, 1906, page 794).

Meters.

[The views of other correspondents on this difficult question would be acceptable. The proper procedure seems to be a matter of considerable doubt.—Eds. E.R.]

LEGAL.

Chitty *v.* British Westinghouse Electric, &c., Co., Ltd.

In the King's Bench Division on Tuesday, before Mr. Justice Bigham and a Special Jury, Mr. Henry Chitty, electrical engineer and inventor, of 4, Lloyd's Avenue, Fenchurch Street, E.C., sued the British Westinghouse Electrical and Manufacturing Co., of Westinghouse Building, Norfolk Street, Strand, for damages for alleged breach of a covenant, and for the return of an electric dynamo which he claimed as his property, or for damages in respect of its loss. Defendants denied that they had committed the alleged breach, and claimed the machine as their own.

Sir Ed. Carson, K.C., Mr. Clovell Salter, K.C., and Mr. J. B. Mathews represented the plaintiff, and Mr. C. A. Cripps, K.C., Mr. Hume Williams, K.C., Mr. A. J. Walter, and Mr. J. G. Graham appeared for the defendant company.

Sir Edward Carson, in opening the case, said plaintiff sued the defendant company in respect of two matters. First for breach of a covenant by which defendants undertook in consideration of plaintiff disclosing certain inventions which he had made not to use those inventions nor to disclose them to others, and he (plaintiff) said that certain disclosures had been made, and the defendants had adapted certain of plaintiff's inventions to certain machines of theirs. That was the breach of covenant, and Mr. Chitty was consequently entitled to damages. The other matter related to a separate agreement, by which a machine, designed by plaintiff, was built in defendants' works, and plaintiff claimed that under the arrangements made the machine was to be his when it was finished. When it was finished the defendants declined to give it up, and plaintiff accordingly claimed to have it returned or damages. Mr. Chitty was an electrical engineer who for many years had been attempting to develop dynamo electrical machines, and as far back as 1892 he obtained a patent in this country for a certain system of ventilating dynamos. The great aim and object of all inventors was to make a light machine at small cost giving a great output with the least possible waste by sparking. Mr. Chitty had been directing his attention to these matters for many years, and he had spent some £10,000 upon his efforts. In 1902 he had completed at Sir Hiram Maxim's works two dynamos, which, according to his idea, ought to give, and which he (counsel) thought would be proved to have given, a very much larger output than any other dynamo up to that date. He brought into that machine not only the improvements he had patented in 1902, but many other matters he had discovered in the meantime. On April 23rd, 1902, he had lodged a provisional specification in regard to certain matters which were included in the machine. He came into contact with a Mr. Spencer, who held some subordinate position in the defendant company's works, and on April 14th, 1902, he received a letter from Mr. R. Belfield, manager of defendants' patent bureau, suggesting that he should appoint an interview with one of their representatives with a view to supplying him with such information as would enable the Westinghouse Electric and Manufacturing Co. to form an opinion as to whether his invention was one with which they should identify themselves. Mr. Chitty replied that he should be pleased to make an appointment, and to meet their representative to discuss matters in a preliminary sense. An appointment was made with Mr. Wells, the manager. They were not, however, in a position to make a bargain without plaintiff disclosing the secrets of his inventions, and as there was, of course, always the danger that certain of the matters might be used by the parties to whom they were confided, plaintiff said that before he told or showed them anything, he must have a strict covenant that they would not use any technical knowledge or information which he gave in the event of matters being off between them. Accordingly, a deed of covenant was entered into upon October 15th, 1902. Plaintiff did not complain that anything which the defendants had used was in breach of any patent of his. If that had been so, he would have had his remedy in an action for infringement of his patent. By that deed the plaintiff covenanted to allow the defendant company to test the machines constructed by him, and the company covenanted not to directly or indirectly disclose or give information to any persons as to the said improvements, the method of construction of machines, or any special technical knowledge communicated or ascertained in the course of the investigations and testing, or to use the same in any way. The jury would appreciate the care plaintiff took of the contract which the defendants were willing to enter into. The whole meaning of it was that if they did not come to terms after the tests, defendants were not to have the benefit of any knowledge or information or invention, which they might acquire from plaintiff in the course of the tests. That was a perfectly fair and reasonable contract, and he thought the jury would come to see, when they learned what had happened, the plaintiff was wise in having the good sense to cause such a deed to be entered into. Shortly after the agreement was entered into, plaintiff was put into communication with Mr. Belfield, manager of defendants' patent bureau, with the purpose, no doubt, of his disclosing, as he did, many of the secrets in connection with his inventions, and when he had disclosed them, Mr. Belfield suggested to him that he should enter into an agreement to allow the defendant company to use, free of charge, any patents which might be taken out in the course of the investigations for two years. Plaintiff absolutely refused, preferring to rest on the agreement of October 15th. After the agreement had been entered into, he removed his dynamo electrical machines from Sir Hiram Maxim's works to the defendant company's works at Trafford Park, Manchester. He explained them to the defendants, and disclosed to them and their experts all his improvements, not merely the improvements under the patents, but certain special features which had been introduced and which had not been in use hitherto by the defendants. The machines were tested, and he believed that there was a question whether they were good or bad. Mr. Chitty would abundantly prove that the tests were highly satisfactory, but except as a collateral question, the question of whether they were good or bad, or whether they turned out to the satisfaction of the defendants, had nothing to do with the case, because the defendants had no right whatever to use any portion of the information or technical knowledge which had been given them in the course of the negotiations and tests. The only question in the case was whether defendants applied to their own use certain information they acquired in the course of the negotiations. On November 13th the whole matter was explained to Mr. Wells, the manager, and on December 14th a second agreement was entered into. The defendants were to construct under the instructions of plaintiff, and from designs prepared by him, a motor combining the essential features of his inventions, and to pay plaintiff's expenses in preparing the designs and in superintending the construction. At the time that agreement was entered into Mr. Wells said that the motor would be plaintiff's when made. Defendants, of course, would be unable to make any use of it under the previous agreement. When they had appropriated certain of plaintiff's inventions they said the machine was theirs, because they built it. Plaintiff, who had spent 15 months upon it, was to get nothing. It was upon that agreement that the second claim was founded. Plaintiff said that he ought to have the machine, or that, as a matter of business between them, they ought to share. The two dynamos were completed in March, 1903. According to plaintiff the tests upon them were absolutely satisfactory, but on March 27th Mr. Malcolm MacLaren, one of defendants' engineers, made a report, in which he found considerable fault with them, and, on the whole, reported unfavourably upon the machines. That report was not accepted by plaintiff, who sent in an analysis, pointing out serious errors. Notwithstanding that report defendants went on for another year or 15 months trying to get information, and as late as three months after that report they put into plaintiff's hands an order for the erection under his guidance of a turbo-generator. It was to be constructed at their expense under his supervision and from his drawings. Plaintiff's great object was to improve the system of ventilation in the generators. He had what he called secondary ventilating devices, and he disclosed to defendants certain ventilating plates of thin sheet-steel standards. It had always been necessary to put in certain plates with a view to creating a draught of air through the machine, so as to keep it cool. Up to the time plaintiff came into the business, defendants had always been accustomed to use heavy and costly solid-cast ventilating plates, in which the vanes were solidly cast, and they did not supply nearly as much draught as plaintiff's improvement, which they said defendants had now adopted. The great benefit of plaintiff's invention was that it was easy and cheap of construction, it was much thinner and lighter, and it was more effective. Instead of the vanes being solid, plaintiff invented the device of punching through a tongue, on which he constructed the vanes. This invention was disclosed to defendants, and he thought he would be able to show that they had deliberately taken and applied it to a large number of their machines in breach of their agreement. On February 2nd, 1903, plaintiff took his drawings for these ventilating plates into defendants' patent bureau, and he had no reason to doubt that defendants were acting perfectly *bonâ fide* in the matter till he heard some time in the month of May that they were beginning to use the ventilating plates, or plates formed on the same principle, in some of their machines. Upon April 20th, 1903, Mr. MacLean, who was in defendants' employ, actually suggested that he should take out a patent for a new and almost identical style of ventilating plate, although under their agreement defendants were bound to take out patents in plaintiff's name. Mr. Cachemaille, who was in the patent bureau, however, asked what about Mr. Chitty's ventilating plate; and, when the matter was submitted to Mr. Wells, he suspended all further action on Mr. MacLean's invention until further instructions, in order that there should be no question arise as to the company in any way interfering with plaintiff's invention. No further instructions were given, and nothing was done towards filing specifications on behalf of Mr. MacLean. Thus they had the plaintiff bringing his ventilating plate into defendants' office in February, Mr. MacLean sub-

sequently sending in drawings and specifications, and defendants saying they would not go on with it, having regard to the previous drawings furnished by plaintiff. Notwithstanding the admitted state of facts, however, the defendants, on their own admission, had been using these ventilating plates, for which they could not get a patent, having regard to the previous drawings and designs made by Mr. Chitty. It seemed to him that the jury would have no difficulty in coming to a decision as to who had a right to the ventilating plates. When plaintiff ascertained that they were being used, he wrote to Mr. Wells, the general manager, on May 26th, complaining; but he got no answer or explanation, and he then instructed his solicitors. Sir Edward then drew the jury's attention to defendants' answers to certain interrogatories, contending that they amounted to an admission that prior to the date of their agreement with the plaintiff they had never manufactured anything but heavy cast metal plates. They had even to admit that they had not one particle of information in their office.

Mr. Justice Bigham: No, that is just what they don't admit. They say they never used these things (the improved ventilating plate), but they do not say they had not information in their offices.

Sir Ed. Carson said it was certainly curious, if they knew of them in their offices, that they never used them, and that as soon as they received the information from plaintiff they did begin to use them. The machines in which these plates had been put, brought in something like £228,000. They were a distinct improvement and of distinct use or they would never have been put in. There were two other branches of invention which Mr. Chitty brought before the company. He had an arrangement of auxiliary poles and windings to regulate the current so as to prevent sparking. He did not profess that it was a new matter or that he had invented it, but it had not been used by dynamo manufacturers, and certainly the defendants had never used it. He brought it to their notice, and they admitted that it had never been used by them before. Plaintiff had, however, invented a certain arrangement of slots in the pole-piece, placed parallel to the axis of rotation, the object of which was to prevent cross-magnetisation; and this in combination with the sparkless commutation was a most important invention. In May, 1903, when they had had considerable experience of his ability, defendants asked plaintiff to design and superintend the construction of a certain turbo-generator which they were going to erect at the Savoy Hotel. He made all the necessary drawings, and the machine was constructed under his supervision. He introduced the sparkless commutation and the arrangement of slots. They had got provisional protection here and in certain other countries, but when they went to Germany, where they made closer investigations, they found that there was either an existing patent or an application for a patent which was held in some way or other to prevent the plaintiff from obtaining his patent in Germany. Defendants advised him for the present to withdraw the application, because if it had been unsuccessful the whole thing would have become public. But, having found that out, they brought over to this country a Mr. Beyer to construct a turbo-generator—there were four altogether ordered for the Savoy Hotel—and it was clear that having got the knowledge, the plaintiff could not get his patent in Germany. They thought that under their agreement they had a right to adopt the sparkless commutation and the arrangement of slots to their own work. Concluding, Sir Edward said the defendants were a rich company which could set plaintiff at defiance. They kept the machines, dismantled them, so that they looked like a failure, and he was left, after 15 months with them without any exhibition of success so far as they were concerned, whilst they had put into 219 (?) of their machines the very improvements they had got from his technical knowledge and information. The machines that the defendants could not retain were now an absolute success, and were by far the best and cheapest machine, giving the greatest possible output of electrical energy upon the market. The defendants, of course, had got all they wanted. They had had the advantage of plaintiff's skill and information for a year, and he had not got a penny. He asked the jury to say what was the value of the information he had given and which defendants had appropriated in breach of their agreement.

Mr. H. T. Chitty, examined, said he was a civil engineer, and had devoted a considerable amount of money and research in connection with dynamo-electric machines. He had patented a device in 1892, and had improved on that in 1902. In the patent of 1892 ventilating passages were carried right through the pole-pieces. The object of the 1892 patent was the ventilation of the dynamo, which was to get rid of the heat which was generated. It was desirable to get rid of the heat because the heat limited the output, and a machine was priced according to the output or the work it would do. The better they were able to get rid of the heat loss in the machine, the higher would be the rating in that machine. The practical harm the heat did was this: You had to rate the machine at such a load as was limited by the temperature rise specified. Mechanical power had to be converted in this machine into electrical power. He patented a device in 1892, and in April, 1902, he got provisional protection for an improvement or development in the ventilating scheme. In the course of his researches, he also devised other improvements. In 1902 he constructed two dynamo-electric machines—at least they were built under his supervision at the works of Sir Hiram Maxim. These machines contained his ventilating improvements, and certain of his other improvements. In addition to the ventilation difficulty, there was difficulty in relation to the distorting effect of the armature current. He had devised a system of slots, which was, in his judgment, likely to reduce that difficulty. There was also a third matter, viz., the means of getting good commutation, that was to say, sparkless commutators. That was done by the use of a system of auxiliary poles and pole windings. The auxiliary poles were used in the two machines in question, but the system of slots just referred to was not used, but there was a partial equivalent in a central division right through the pole-pieces. After some preliminary correspondence, he had an interview with Mr. Wells, the manager of the defendants' works, on June 5th, 1902. At that interview, Mr. Wells asked witness to explain to him not only the results, but how those results were obtained—the results in point of output. He gave Mr. Wells the results of the outputs obtained by experiments with other machines he had had constructed years previously. The experiments showed that a machine of his which weighed 8 or 9 cwt., could give as much output as any other weighing 40 or 50 cwt. He had at the date of the interview, one invention protected and published, and an improvement on that which was not published. He explained to Mr. Wells that there were a number of matters which he had not protected, and he declined to give him any information as to how he acquired those results, and said that until he was protected, he could not disclose these. He told him that until he got something in the nature of a covenant, he could not give any information except such as he could obtain from his patent. He told him that he had discovered other ideas not embodied in the two machines. Ultimately, it was agreed that there should be a deed of covenant, and it was prepared on October 15th, 1902. After that had been executed, he sent his two machines to the defendants' works at Manchester. Besides that he had made disclosures of his patents and ideas to the Westinghouse Patent Bureau.

Mr. Cripps said that the Westinghouse Patent Bureau was not part of the Westinghouse Co.

Examination continued; he told Mr. Wells that certain of his friends were proposing to form a syndicate to acquire the foreign and Colonial patents, and were prepared to "put up" £3,000 or £4,000. Mr. Wells proposed that the Patent Bureau should acquire the patents, the defendant company finding the money. He disclosed to the Patent Bureau all his discoveries and ideas in general terms, but he could not say that he disclosed everything in minor details. He disclosed his improvements in the ventilating system, and they prepared his complete specification, and he mentioned several other matters to them before any tests were made at the defendants' works. The Patents Bureau made a number of applications in his name for taking out patents. He had a conversation with Mr. Wells at the Queen's Hotel as to the machines and tests which had been made, and as to the various improvements he had made and not included in the machines in question, and it was suggested that a new machine should be built embodying all these features, and also the other improvements which he had explained, and this resulted in the agreement which was drawn up on November 14th. By that agreement witness had to assign one-eighth interest in the patent. In pursuance of that agreement an experimental machine was built at the defendants' works, and some adjustments and alterations were made under witness's supervision in the two machines built at the Hiram-Maxim Laboratory. After the first of the tests he was handed a copy of Mr. MacLaren's report, by defendants' works manager. On the whole it was a very unfavourable report. It was dated March 17th, 1903. The tests of his two machines showed very good results. The first test, on March 24th, 1903, extended for seven hours with a fairly constant load kept on the whole time. It was a test to find out to what degree the machine would heat up under a given load. An ordinary machine of the same weight and size would probably do 20 kw., but his machine was actually running with 50 kw.—two and half times as much as an ordinary machine. The next test was made on April 2nd of that year. The substantial result was that the machine ran with nearly 150 kw.—an enormous load for such a machine. The load was on for about 15 minutes, and the commutation was very good. They had the third test on May 16th, 1903, the result being very similar to the last. The defendants declined to give up to him the machine made under the agreement of November 14th. He valued it at what it would cost him to replace it. He put an estimate of £1,500 upon it, but in reality he could not get it built for that. In addition to this, he disclosed secondary ventilation devices. He disclosed to the defendants the method of constructing the ventilating plate. In May he was informed that an attempt had been made to obtain a patent for one of his inventions, and he put the matter into the hands of his solicitors. The price of the dynamo varied according to the output, and the latter was increased by his methods, and, therefore, it would give a greater selling value to the machine. He did not claim any invention as to the auxiliary poles and windings. At the date of the deed, the system of auxiliary poles and windings was not used in practice by any manufacturer. He used his plan of slots to prevent distortion or cross induction. He fully disclosed this combination.

The hearing was adjourned.

(To be continued.)

Folkestone Electricity Supply Co.

At the Folkestone Police Court, last Saturday week, this company was fined £3 and 13s. costs for breach of the Factory and Workshops Act, by not producing the general register when requested to do so by the Government Inspector on April 27th.

PARLIAMENTARY.

L.C.C. Electric Supply Bill.

(*Continued from page* 918.)

TUESDAY, JUNE 12TH.

THE Select Committee of the House of Commons which has this Bill under consideration resumed its sittings on Tuesday, when Mr. Balfour Browne, K.C., opened the case for the Electric Supply Companies by calling Mr. John Conacher, manager of the Metropolitan Co.

Mr. CONACHER put in a number of tables on behalf of the companies. One of these tables showed that their authorised capital amounted to £18,550,013. The total paid-up capital was £12,622,633, leaving a balance unissued of £5,927,350. The loan capital was at rates varying from 3½ to 5 per cent. The Metropolitan Co. had authorised share capital powers of £1,500,000, and of this £1,380,605 had been paid up. The loan capital was £1,500,000. Of this £220,000 had been borrowed at 4½ per cent., and £250,000 at 3½ per cent. The capital expended by the company was £1,696,007. Another table put in by the witness showed the units sold for all purposes by the companies in each year from 1893 to 1905 inclusive, together with the revenue received therefrom (less bad debts) and the average price per unit. From this table it appeared that in 1893 the units sold were 10,232,958; the revenue was £265,259, and the average price 6·22d. In 1900 the number of units sold was 53,191,221, the revenue £1,001,348, and the average price 4·52d. In 1905 the figures were 119,546,734 units, £1,615,259 revenue, and 3·24d. the average price.

Mr. CONACHER put in a copy of the following letter, addressed to the Board of Trade by the London electric supply companies:—

London, *December* 21*st*, 1905.

Sir,—We, the undersigned, being the whole of the electric supply companies of London, are of opinion that the advantages of cheap generation of electricity could speedily, and at a relatively small addition to capital already expended, be given throughout the whole of London if Clause 11 of the Supply of Electricity Bill, introduced by your Department into the House of Commons last session, after having been passed by the House of Lords in the previou session, were to become law. Many of the undersigned companies already possess large generating stations, favourably situated and equipped for economical generation, and for wide distribution of energy throughout the several districts of London in or near which they have been erected, and if the provisions referred to become operative, the other and smaller companies, and the Metropolitan Borough Councils, who, by reason of the restricted nature of their supply areas, are unable unaided to obtain the advantages of generation on a large scale, would be placed in a position to share in those advantages with a smaller outlay of capital and with less disturbance of streets than would be obtained by any other method. We therefore beg very respectfully to suggest to the Board of Trade that they should, at an early stage of the ensuing session, submit to Parliament a short measure embodying, as regards the London companies, the provisions of Clause 11 of the Bill of last session; and also, if considered desirable, Clause 10 and Sub-sections 2 and 3 of Clause 8. We beg further to suggest the desirability of applying to all London Electric Supply Companies the provisions of Sec. 21 of the County of London Electric Supply Co.'s Act, 1905, and Sec. 27 of the Metropolitan Electric Supply Co. (Various Powers) Act, 1905, with respect to the supply of energy for the purpose of haulage or traction. We shall be pleased to arrange at any time for a deputation to wait upon the President if he should desire to have further information from the companies.—We are, Sir, your obedient servants,

Brompton and Kensington Electric Supply Co., Ltd.
Charing Cross, West End and City Electricity Supply Co., Ltd.
Chelsea Electricity Supply Co., Ltd.
City of London Electric Lighting Co., Ltd.
County of London Electric Supply Co., Ltd.
Kensington and Knightsbridge Electric Lighting Co., Ltd.
London Electric Supply Corporation, Ltd.
Metropolitan Electric Supply Co., Ltd.
Notting Hill Electric Lighting Co., Ltd.
St. James' and Pall Mall Electric Light Co., Ltd.
South London Electric Supply Corporation, Ltd.
South Metropolitan Electric Light and Power Co., Ltd.
Westminster Electric Supply Corporation, Ltd.

The Secretary, Board of Trade,
Whitehall, S.W.

To this letter Mr. Pelham had replied to the effect that the Board was considering the propriety of proceeding with the Supply of Electricity Bill this session, and in the event of their doing so would consider the question of providing for the supply of electricity to railways, tramways, &c., in addition to the other questions referred to in the letter.

(*To be continued.*)

London Outer Circle Railway.

(*Continued from page* 901.)

SIR J. DOUGHTY'S Select Committee of the House of Commons, which is considering this Bill, resumed its sittings on Tuesday.

Mr. ERSKINE POLLOCK, K.C., stated that the Brentford Gas Co. had withdrawn its opposition to the scheme pending the consideration of a clause which had been submitted by the promoters. The clause, counsel said, was without prejudice to the right of opposition if the Bill should reach the second House.

Sir RALPH LITTLER, K.C., then opened the case for the opposition of the London and North-Western and North London Railway Companies. It was ludicrous to suggest that there could be a through circular system of trains from one system to another. Although the line would, he considered, be unsuccessful, it would certainly take some traffic from the North London Line, and there was nothing worse for a railway company than having an impecunious neighbour troubling it. The circular route met no public want, and throughout the whole of the 33 miles of route there had been no resolution of any public body in favour of the scheme.

(To be continued.)

Third Readings.—In the House of Commons on June 7th the Baker Street and Waterloo Railway Bill, the Lancashire Electric Power Bill, and the St. Pancras Electricity Bill, were read a third time.

In the House of Commons last Friday the following Bills were read a third time:—London County Council (Tramways and Improvements) Bill, Lancashire Tramways (Extension of Time) Bill, and the Metropolitan District Railway Bill.

BUSINESS NOTES.

An Interesting Turbine Experience.—We gather from a note in *Engineering* that the large 5,500-KW. turbo-generator of the Willans & Robinson type, supplied to the Kent Avenue station by the Allis-Chalmers Co., of Milwaukee, has been submitted to a very severe test of its mechanical strength. By some accident a large jack-knife was left inside the turbine before it was closed up, and the machine ran with this obstruction inside it, a knife blade being wedged between the stator and rotor. This condition of affairs lasted for nearly a month, the maximum load taken being 9,800 KW., whilst on occasion the load averaged 8,000 KW. for 1½ hours. Upon opening up the turbine the obstruction was discovered. It was found that a piece of steel from the knife had been wedged into such a position that it had acted like a lathe-tool, and had turned a groove on the drum $\frac{3}{16}$ in. deep by $\frac{3}{8}$ in. wide. This had loosened the caulking strip which held the ring of blades in place, loosening the latter, so that the channel-shaped shroud ring, which is riveted over the ends of the blades, came into contact with the fixed cylinder, with the consequence that its flanges had been almost worn away. Nevertheless, not a single blade came out, and, as stated, the turbine continued to work under, at times, an enormous overload. The incident is quoted by our contemporary as a striking testimony to the mechanical efficiency of the system of holding the blades introduced by Captain Sankey, which is that adopted by the builders. As it was not feasible at the time of the discovery to lay the turbine off long enough for permanent repairs, the damaged ring was merely removed, and the cover being replaced, the turbine was immediately set to work again.

Catalogues and Lists.—MESSRS. CROMPTON & CO., LTD., Salisbury House, E.C.—Two new catalogues, one (No. D 27) setting out in convenient form the various data and descriptive matter concerning their alternating-current generators and motors, sub-station converters, induction motors, polyphase motors, transformers, main switches, motor panels, &c.; the other (No. S 8) gives fully illustrated details of the company's switchgear, including main and change-over switches, lever switches, circuit-breakers, cut-outs, fuses, battery-regulating switches, and so on.

BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Illustrated pamphlet No. 197, giving detailed description of, and tabulated data concerning, their type D A continuous-current motors and generators. No. 196 is devoted to the Meridian lamp No. 4, which was recently referred to in our pages. No. 195 describes the company's rheostatic controllers, giving tabulated figures for their use for crane and hoist work, for machine tools, printing presses and mining locomotives, and particularising resistances for use with the controllers. A sheet has also been issued for filing with these and other lists as an index to current pamphlets.

MESSRS. KELVIN & JAMES WHITE, LTD., 66, Victoria Street, S.W.—New pamphlet giving full particulars of, and method of using, the Kelvin ampere balances and watt balances. This is the fourteenth edition of this pamphlet, which was published when the firm originally put this instrument on the market; it has been brought up to date, and gives full particulars of the latest types of balances, embodying all the various improvements that have been introduced to facilitate manipulation and to make the instruments suitable for modern requirements. In order to facilitate the reading of the instrument when used on a circuit with a slightly varying load, dashpots have been fitted on some types of balances with satisfactory result. The Board of Trade pattern of this instrument is also illustrated. Owing to the extended use of alternating current, fuller particulars are given of the watt balances and the method of connecting same in circuit with the resistance usually supplied, and the moving coils of these instruments are now so designed that the self-induction is reduced to a minimum. Fuller particulars are also given of the use of composite balances as an amperemeter, voltmeter and wattmeter, and various improvements have been introduced to facilitate these measurements. A full list of prices is given. Information is also given about the overall and shipping sizes and weights of each balance, and this will be of particular value to foreign clients. A list appears of some of the users of these instruments for laboratory, central

station and test-room work. The firm will be glad to send copies of this list to any of their clients.

ZURCHER TELEPHONGESELLSCHAFT.—We have received a leaflet bearing this name, describing the advantages of a new microphone, but giving no particulars of its construction.

MESSRS. DAVIDSON & Co., LTD., Sirocco Engineering Works, Belfast.—Four recently issued publications: No. 2,002, giving a full description with illustrations and test curves, also tabulated data of outputs, weights and dimensions of their Sirocco centrifugal fan; No. 2,000, dealing in similar style with Sirocco fans for forge fires; No. 2,003 supplying like information concerning electric propeller fans for continuous current; and No. 1,001, which is an attractive 32-page brochure entitled "The Mechanical Ventilation of Mines," in which are described examples of installations of surface and underground fans, also centrifugal mine fans. These lists are all well printed and illustrated.

SIEMENS BROS. DYNAMO WORKS, LTD., Westminster, S.W.—Two new publications to be placed on their file for reference:—Circular YM111, giving a general description of the various types of crane controllers made at the Stafford works, and pamphlet YM14 describing the construction of their standard "U R" alternator, and giving data of weights and dimensions. This pamphlet is illustrated with views of machines recently constructed At the end a few views of specially large machines of other types are also shown.

MESSRS. ARCHIBALD J. WRIGHT, LTD, Leyton Green Road, N.E. —Illustrated circular showing, and giving prices of, a variety of automobile accessories and electrical instruments.

ELECTRICAL POWER STORAGE CO., LTD., London, E.C.—Price list particularising their small storage cells; also Section C pamphlet giving information and prices concerning the "Epsco" ignition batteries.

MESSRS. RICHARD WOODS & Co., Sanctuary Chambers, Westminster, S.W.—Well illustrated publication containing description of the Hyde electric elevators, which are manufactured by the Hyde Electric Manufacturing Co., Ltd, of Hyde, Manchester. Messrs. Woods are sole agents for the firm for London and the South of England, and they will send copies of the brochure to engineers or architects who are interested. Particulars are given of the general design, details of the reduction gearing, system of control, methods of operation, &c.

Mr. DOUGLAS WELLS, Brussels.—Illustrated catalogue (in French) particularising the manufactures of the Mica Boiler Covering Co., Ltd., for whom he is agent.

MESSRS. CHAMBERS, SCOTT & Co., Dalziel Engineering Works, Motherwell, N.B.—An eight-page list of half-tone illustrations showing their cranes, including electric overhead and travelling cranes, steam and electric derrick, hydraulic jib and portable hand cranes.

MESSRS. C. F. ADOLPH & Co., 31, Great Sutton Street, Clerkenwell, E.C.—Circular stating prices of "M" pole-finding paper. A second list describes their new "Reliable" pole indicator, which consists of two electrodes enclosed in a transparent glass tube containing an electrically sensitive liquid. The negative electrode at once turns vividly red on connecting the wires of different polarity to each end of the instrument. This indicating colour disappears again immediately after disconnection.

GENERAL ELECTRIC CO., LTD., London.—List giving particulars of a number of their leading lines in electric light fixtures, which they are offering at specially reduced prices for quantity orders. The company has also issued a new sale list of artistic electric light fittings, which are being offered at reduced prices, they being patterns which are not illustrated in the present edition of their catalogue, and for which therefore the demand does not warrant holding them in stock. We are informed that the reductions in prices in many cases "range up to almost 100 per cent.," which we suppose means they are given away (is there a discount off that?)—but we leave our readers to find that out for themselves, as we are unable to discover reductions of this magnitude.

THE BRITISH ELECTRIC CALIBRATED FUSE CO., 14, Golden Lane, E.C.—16-pp. catalogue containing description, prices and illustrations of their various types of fuses, including "Pyrotin" fuse wire and strip, Mordey enclosed fuses, porcelain handle switch fuses, magazine fuses and fuse carriers, &c.

MESSRS. PH. BONVILLAIN & E. RONCERAY, Paris-Aubervilliers.—40 pp. illustrated pamphlet describing in English their universal system of machine moulding. An automatic sand-mixing and crushing machine working with wet sand; a new process of making pattern plates; the universal moulding and assembling machines and their operation—all these are particularised, and illustrations are given of a number of sample pattern plates for railway, dynamo and tool work.

For Sale.—Hereford County and City Asylum Authorities invite tenders for the purchase of glass accumulator boxes, &c. MESSRS. W. DENNY & BROS., Dumbarton, are offering for sale the plant, &c., at Kirkton Hill electric light station. Some particulars appear among our advertisements to-day.

Book Notices.—*Train Lighting: A Description of the Leitner-Lucas System.*—This is a 74-page book containing an exhaustive account of this system, about which a good deal has already been published in the ELECTRICAL REVIEW. The system, its principal adjuncts and advantages, are all stated in detail with many illustrations, and particulars are also set out of the three months' sealed test on the G.W. Railway. Instructions for setting up complete equipments are followed by a detailed technical description. The licensees are Messrs. Accumulator Industries, Ltd., of Woking, the sole concessionaires being Messrs. G. D. Peters & Co., of Moorfields, London, E.C.

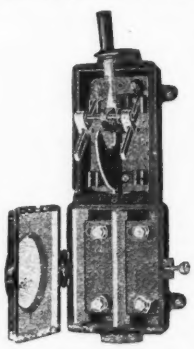
Messrs. Archibald Constable & Co. will shortly publish a book entitled "Chemistry of Paints and Paint Vehicles," by C. H. Hall.

We have received from the Health Resorts Development Association (2, Gray's Inn Road, E.C.) a further batch of interesting and useful holiday resort handbooks. These relate respectively to Lowestoft, Weymouth, Llandrindod Wells, Leamington and Clifton, and are all published for the Town Councils. We may again add that our readers can obtain copies by writing to the town clerk of any of the places named.

We have received a copy of the June quarterly issue of the *Rhodesia Review*. From a perusal of its various articles on Rhodesian mining and finance, we should think it a most interesting and valuable magazine for all who have put money into Rhodesian companies.

Report of the Electrical Railway Test Commission of the Louisiana Purchase Exposition. New York: McGraw Publishing Co. $6.00 net.

Trade Announcements.—MESSRS. W. H. ISHERWOOD AND Co., of Carlton Mills, Leeds, have just taken over the switch and fuse manufacturing business hitherto carried on by Messrs. Franklin and Isaacson, of Great Wilson Street, Leeds. The latter firm is now confining itself to oil and petrol motor manufacture. A specimen of Messrs. Isherwood's switches is shown in the accompanying illustration.



ISHERWOOD'S SWITCH.

MESSRS. E. P. ALLAM & Co. have appointed Messrs. T. Hood & Co., of 26, Bath Street, Bristol, their sole selling agents for the West of England and South Wales; Messrs. R. A. Fullerton and Co, of 116, Hope Street, Glasgow, are representing them in Scotland; and Messrs. Fenwick Reay & Co., of 50, Granger Street, Newcastle-on-Tyne, in the Northumberland and Durham area.

MESSRS. KRAMOS, LTD., of Bath, have just opened a head sales office and showrooms at 169 and 170, Shoreditch High Street, E.C. All correspondence should be addressed there in future.

In order to provide additional capital for increased business, the Electric Heating Co. has been converted into a limited company, under the style of the PHŒNIX ELECTRIC HEATING CO., LTD. The company are the sole makers of the Phœnix electric heating and cooking appliances. Though the staff has been largely increased, the technical management remains as before. In addition to the present showrooms at 3, Holborn Place, further showroom accommodation is being provided at No. 116, Great Portland Street, W. All communications should be addressed to the general manager of the company, 3, Holborn Place, W.C.

The NEW BROTHERTON TUBE CO., LTD., have removed their Glasgow offices and warehouse to 198A, St. Vincent Street, under the management of Mr. R. S. Hunter. A large stock of conduit tubes and fittings is held there.

MESSRS. MACARTNEY, MCELROY & CO., LTD., are removing to more spacious and convenient offices at Caxton House, Westminster. All letters should be addressed there after 23rd inst.

Dissolutions and Liquidations.—SOUTH LANCASHIRE ELECTRIC TRACTION AND POWER CO., LTD.—A meeting is to be held on July 9th at 24, North John Street, Liverpool, to hear an account of the winding up from the liquidator, Mr. W. H. Alexander.

THE DISTRICT ELECTRIC CO., 39, Berry Street, Wolverhampton. —Messrs. L. Stallybrass and L. S. Aldridge have dissolved partnership. Mr. Aldridge will continue the business under the old name.

Robertson Sports.—On Whit Monday the employés of the ROBERTSON ELECTRIC LAMPS, LTD., from Brook Green, Hammersmith, held their first sports on their new and spacious ground at Old Oak Road, Shepherd's Bush. This ground has been provided as a continuation of the social club, so that sports and other outdoor amusements can be enjoyed by the club members. The social club, which has been in force for about two years, and which has had a very successful run, formed a committee to provide outdoor amusement, and when their wants were placed before the directors they were met in the usual liberal way. The firm paid for this ground, and built a large pavilion and dressing rooms, and made many improvements. On Tuesday last week there were between three and four hundred present, mostly ladies, and the chief events were a 100 yd. handicap, a ½ mile handicap for men, and a 50 yd. handicap race for the ladies. There were a large number of entries for these, and other interesting items on the programme included three-legged race, egg and spoon race, thread-needle race, skipping, tug-o'-war for the ladies, and the usual races for the men. Besides these sports there were tennis, croquet, quoits, cricket, swings, &c. The prizes were presented by the works manager, Mr. C. Wilson.

The New Waring's.—The new premises in Oxford Street built for the concentration and development of the business of Waring & Gillow, Ltd., were thrown open for a Press view on Saturday last, and during the current week are open for inspection to holders of tickets which were to be had for the asking. The galleries are particularly interesting to every one connected with electric lighting owing to the immense variety of arrangements and fittings, many of them novel and unique. These have been devised to suit the varied styles of the large number of rooms shown completely furnished as demonstrations of what the firm can do in the way of combining good taste and economy. Not only

complete rooms, but model houses are exhibited in the endeavour to simplify the business of house furnishing for beginners. These show how a house can be furnished for £100, £200, £300, £500 and £750 respectively, the style in each case being selected with the object of obtaining the best possible effect for the stipulated outlay. Needless to say, the lighting of these specimen houses shows a diversity of treatment and a variety of effect. In the electric light fittings department of the business a more concentrated display will be found of electroliers, brackets, pendants and other requisites for house lighting.

Turbo-Alternators.—The alternator selected by the Leeds Corporation to be coupled to the Willans turbine is of Dick, Kerr's manufacture. The success achieved by this firm in the design of high-speed alternators suitable for coupling to turbines is evinced by the fact that they have supplied or have under construction machines for the following authorities:—

Glasgow Corporation, four 3,000-KW. sets.
South Metropolitan Electric Supply Co., Ltd., two 1,500-KW. sets.
Leeds Corporation, one 3,000-KW. set.
Lancashire and Yorkshire Railway, one 3,000-KW. set.
Islington Borough Council, one 1,500-KW. set.
Metropolitan Electric Supply Co., one 3,000-KW. set.
Bristol Corporation, two 1,000-KW. sets.
Midland Electric Power Co., two 1,500-KW. sets.
Drake & Gorham, one 750-KW. set.
West Ham Borough Council, one 1,500-KW. set.

B.T.-H. Contracts.—The Warrington Electricity Committee has accepted the tender of the BRITISH THOMSON-HOUSTON Co. for the supply of alternating-current motors for the next 12 months. The Wallasey U.D.C. has accepted the same company's tender for a 12 months' supply of electricity meters for alternating current, suitable for 100 and 200 volts.

The following orders have been booked for their B.T.-H. tramway equipments, cars, &c.:—

Lanarkshire Tramways Co., six double-deck cars.
Stockport Corporation, five double-deck cars.
Colne and Trawden Light Railways, two double-deck cars.
Pontypridd U.D.C., eight double-deck bogie cars with G.E.58 four-turn equipments and B.T.-H. magnetic track brakes.
Dublin and Lucan Electric Railway, one electric locomotive.

Johnson & Phillips's Recent Contracts. — The following contracts have been secured by MESSRS. JOHNSON AND PHILLIPS, LTD.:—

Belfast.—Battery, booster and switchgear for the Tramways and Electricity Committee.
Belfast.—400-KW. dynamo for the Corporation (order placed by Messrs. Combe, Barbour, Ltd.).
Oldham.—Supply of motors, &c., for sale or hire for 12 months, to the Electricity Committee.
Japan.—100 open-type arc lamps for H.I.M. Navy.

A London Installation.—THE ELECTRICAL ENGINEERING AND MAINTENANCE Co. have recently carried out a large electric light installation for the Auctioneers' Institute of the United Kingdom in their new premises at 34, Russell Square, London. Screwed tubing has been used for enclosing the cables and wires; and the fittings, which have been made specially, consist of wrought-iron throughout. The company's automatic system of inter-communication telephones between the various rooms and departments of the building has also been installed. The work was carried out under the direction of Mr. Harold Griffiths, the architect of the Institute.

Bankruptcy Proceedings.—T. F. L. RENE.—Under the receiving order made against Theodore Ferdinand Levy René, described as an electrical engineer, of 64, Catford Hill; lately carrying on business at 6, Snow Hill, and now, or lately, carrying on business at 9, Plum Tree Court, Farringdon Street, E.C., the adjourned meeting of creditors was held on Friday, June 8th, at the London Bankruptcy Court, before Mr. Walter Boyle, Deputy Official Receiver. The debtor was again absent, and the chairman stated that he had no further information to give to the creditors. A resolution was passed for Mr. Walter Osmond, manufacturer, Gardnor Mansions, Hampstead, to act as trustee and wind-up the estate in bankruptcy. The debtor's public examination is appointed for July 13th. A creditor stated that the debtor had sold his business to a company styled René, Ltd., for £7,000 in shares, £6,000 of which represented the goodwill. The only other persons interested in the company, besides the debtor, were his wife, and one, Best, and shares to the extent of £4,000 had been allotted to the debtor, who was further entitled under the purchase agreement to one-half of the profits of the company for 30 years. The object of forming the company was to provide fresh capital for the business, and it was understood that money had been subscribed.

On Monday at the Wandsworth County Court, an application was made for the consolidation of the assets in the bankruptcy of George Webber, William Leslie, and Alice Frances Cheesman, who it will be remembered, are undergoing sentences in respect of the City electrical frauds. The application was granted.

Fire Brigade Tournament.—The eighth annual competition of the London Private Fire Brigade Association took place on Saturday last at the Crystal Palace. Out of a total of 38 brigades, 31 competed in the tournament. Among the competitors were brigades from such places as Rugby, Leicester, Warrington. The result of the contest was that the Robertson Electric Lamps, Ltd., for the second time took the "Marshall" championship cup. Out of a total of six events, the Robertson Brigade was successful in obtaining three first prizes, one second prize, one fourth prize, one fifth prize, and in addition to the championship cup, they became winners of the Hitchcock Shield for the two-men hydrant drill. The aggregate time taken by the Robertson Brigade in the whole six drills, was 220⅘ seconds, which easily established a record for any previous tournament. Congratulations!

LIGHTING and POWER NOTES.

Aberdeen.—The T.C. has under consideration the lighting by electricity of Albyn Place, Rosemount Viaduct, South Mount Street, King Street, Market Street, Victoria Bridge and Road, &c.

Arbroath.—As was recently pointed out, it is the intention of Mr. George Balfour, of London, to make application for a prov. order for the supply of electric light and power within the burgh, and the T.C. has resolved to give its support to Mr. Balfour in obtaining such an order on the basis of an agreement to be entered into with him. The draft agreement is now being considered.

Barnsley.—The T.C. has decided to have the condensing plant at the electricity works re-modelled at a cost of £687.

On the past year's working the E.L. department shows a gross profit of £6,024, and a net profit of £3,152. This sum has been allocated as follows:—£550 to the rates, £1,500 to the reserve, and £500 on loan to the public lighting, &c., leaving a balance of £602. The accumulated profits now amount to £3,831.

Brandon.—The B. of T. has informed the U.D.C. that it has granted the Mid-Durham E.L. Order.

Brighton.—Accounts of the municipal electrical undertaking, just issued, for the year ended in March, show that the total capital expenditure has reached over £700,000. The total revenue for the year was £86,076, and the gross profit £37,432, but after providing interest and sinking fund there was a deficit of £976, this being due to the large amount of unproductive capital sunk in the recently completed Southwick power station and plant. The latter station, which contains an equipment of three 1,800-KW. three-phase Westinghouse turbo-generators, with a water-tube boiler plant and induced draught, is to be opened on Saturday next.

The Electricity Committee has been forced by circumstances to declare that the cost of the luncheon in connection with the ceremony of opening the Southwick power station shall not come out of the pockets of the ratepayers. The Right Hon. John Burns having absolutely declined the request if the ratepayers were to be saddled with the expense.

Bury.—In his tenth annual report of the working of the Corporation electricity works, the engineer points out that at March 31st, 1906, there were 453 consumers and 50,622 8-C.P. lamps connected. The units sold during the past year were:—Private lighting, 347,035; public lighting, 59,014; public clock, 1,055; motors and heating, 356,189—total, 763,293; tramways, 1,106,267; grand total, 1,869,560. The maximum load was 1,144 KW., and load factor, 18·6 per cent. It is of interest to note that although the tramway department has used 444,017 more units than in the previous year, the maximum load has decreased from 715 KW. to 676 KW., with beneficial results to the load factor. There has been added to the plant one 500-KW. generating set, one jet condenser, three superheaters, a mechanical stoker, &c., and the generating plant now installed is capable of dealing with a maximum load of 1,760 KW. Despite the reduced charge decided upon last year, there is a gross profit of £7,771, equal to 9·6 per cent. on the average capital employed, compared with £6,740, equal to 9 per cent. for the previous year. £5,254, equal to 6½ per cent. on the average capital, is required to pay interest on loans and sinking fund, leaving a net profit of £2,517, equal to 3·1 per cent. on the average capital, to be used to assist the rates and to add to the reserve fund. From this profit Mr. Watson recommends a further reduction in price, with special attention to the possibility of building up a large demand for power purposes.

Canada.—Our Toronto correspondent sends the following:—The Niagara, Lockport and Ontario Power Co. has decided to install another 10,000-H.P. generator, and work has already been commenced. The company's power transmission line is about 160 miles long, being the longest east of the Rocky Mountains. The power plant of the company is on the Canadian side, where there are three 10,000-H.P. generators now in operation. Energy is transmitted down the gorge of the Niagara River about four miles, where there is a 600-ft. span to the American bank. Nine cables, each having 19 strands of No. 5 wire are used. From this point the line runs through Lockport, Medina, Rochester and numerous smaller places to Syracuse, New York State. Several of the steam roads in this neighbourhood are now being electrified, and it is understood that some of these will purchase power from the company for the purpose.

The Greenwood Electric Co., Ltd., is arranging for the acquisition of water-power at Boundary Falls for supplying electric power to the city of Greenwood and the town of Midway, British Columbia. These falls will develop 150-300 H.P. Owing to the fact that 150 H.P., the minimum output of the falls, will not supply the growing needs of both places, it is proposed to install a suitable plant, using a reserve steam unit and a storage dam of 1,000,000 cb. ft. to carry over the peak of the load. As the load factor of the system will not exceed 50 per cent. of the total contracted load, it is not expected that steam will be needed except in cases of emergency.

Cannock.—The *London Gazette* for June 12th contains notification of the intention of the U.D.C. to transfer its electrical lighting order (1901) to the Shropshire, Worcestershire and Staffordshire Electric Power Co. for £550.

Canterbury.—The T.C. has reduced the price of electricity for lighting by ½d. per unit as from April 1st last, making the flat rate 4½d. per unit, and the maximum demand rate, 7d. and 1½d. For power and heat, discounts will be allowed as follows:—500 units per annum, 5 per cent; 1,000, 15 per cent.; 2,500, 20 per cent.; 5,000, 30 per cent.; 7,500, 40 per cent.; 10,000, 50 per cent.

Cheltenham.—A member of the T.C. has given notice, that at the July meeting of the Council he will move that it is desirable in the interest of the ratepayers to consider the advisability of selling the E.L. undertaking upon terms that will reimburse the Council the full amount expended, and fully safeguard the nature and price of the supply of energy both for public and private lighting, "thereby obviating further capital expenditure by the Council and the possible risks and disadvantages attendant upon the management and control of the undertaking by the municipality."

Chesterfield.—Mr. R. L. Acland, the borough electrical engineer and tramways manager, in his annual report concerning the fourth year of working of the lighting department, gives the following particulars:—Total capital expenditure, £53,031; total revenue, £8,336; total costs, £3,632; interest and sinking fund, £3,214; net balance, £1,490. The balance has been appropriated as follows:—Written off capital account on meters, motors and consumers' services, £720; balance to reserve fund, £771, which stands after 4¼ years' working at £2,801, during which time a total of £1,517 has also been written off capital account. Altogether 836,608 units have been sold. The total working cost was 1·04d. per unit, including ·696d. for generation, and ·345d. for general charges.

A new sub-station for supplying energy for lighting at 240 volts from the traction feeders is now regularly at work, and under the control of a Tirrill regulator the pressure is kept absolutely steady. This is interesting as the first installation of this particular kind in this country.

Chile.—The Chilean *Diario Oficial* of April 12th contains the copy of a decree authorising Don Roberto L. Beausire, president of the "Sociedad Fabrico de Sacos," to supply the town of Llai Llai and its vicinity with electric light and motive power. —*Board of Trade Journal.*

Colchester.—The T.C. on June 6th decided to reduce the price of electricity for lighting by ½d. per unit, and fixed the scale of charges for power as under:—Up to 50 units per quarter, 4d. per unit; over 50 and up to 100, 3d.; beyond that amount 2d., less 5 per cent. discount for prompt payment. For tramway purposes energy will be supplied for the year at 1½d. per unit.

Continental Notes.—Italy.—A company has just been formed in Genoa with a capital of £20,000, and the title La Società per le Forze Idranliche dell-Alta Scrivia, to put down plant to utilise the water power of the River Brevenna, in the generation of electrical energy for lighting and power purposes.

A concession has been granted by the authorities of the province of Caneo to put down a plant to utilise the water power of the River Varaila at Sampeyre, near Rorre, in the generation of electrical energy for lighting and power purposes.

Derby.—The Electric Lighting Committee of the Corporation reported at a special meeting of that body last week that it had been decided—the approval of the Highways Committee having been obtained—to light the tram route from the Normanton Hotel to the Cavendish Hotel by an arc lamp on alternate poles and an incandescent lamp on each pole at a cost of £350. A considerable discussion arose, an amendment being moved in favour of gas, and defeated, and the original proposal being carried by a large majority.

Epsom.—The U.D.C. on June 6th decided to provide a 300-kw. steam dynamo, water-tube boiler and induced draught apparatus for the electricity works, at a cost of £3,145.

Fareham.—The U.D.C. has decided to apply to the L.G.B. for a loan of £800, £270 of which is for a 60-kw. alternator, £300 in respect of money over spent, and £200 for future extensions.

Glasgow.—At a meeting of the Electricity Committee of the T.C. the engineer reported that he had received from several engineering firms in the city, applications for a very large supply of electricity for their works, but that in order to give the same it would be necessary to put down motor-generators for transforming the energy to a voltage suitable for their several requirements. He also stated that the firms in question were prepared to pay the fixed charges for electricity for power purposes, and to give the usual guarantees as to the minimum quantities of energy which they would take, and the periods during which the same would be taken. The Committee, having considered the matter, resolved to recommend that agreements should be entered into with the firms referred to, and that the engineer be authorised to obtain quotations for four motor-generators for the purpose indicated.

Gloucester.—The report of the borough electrical engineer for the past year's working shows that the capital expenditure has risen from £75,239 to £84,083; the revenue amounted to £11,831, and the expenditure to £5,807, leaving a gross profit of £6,024. Out of this balance the sum of £4,622 has been allocated to financial charges, and £768 towards extinguishing the previous deficits, leaving a reserve balance of £634. There were 503 consumers and 41,344 equivalent 8-c.p. lamps connected at the end of the year.

Hove.—The Lighting Committee has recommended the T.C. to exercise the option to take current in bulk from Brighton T.C. at 5d. per unit for the first hour, and 1d. afterwards, on or after January 1st, 1907. The present rate is 4½d. and 1½d.

Leigh (Lancs.).—We regret that, in our last issue, we inadvertently belittled the financial results of the past year's working of the electricity undertaking. It appears that a gross profit of £2,316 and a net profit of £249 resulted, while the £52 net profit mentioned is the result since the commencement of the undertaking.

Llanelly.—The L.G.B. has sanctioned a loan of £6,000 to the U.D.C. for the purpose of its electricity scheme. An agreement has been entered into with the South Wales Power Co., which provides that the latter shall commence to supply energy on June 1st or such later date as may be arranged. The Traction Co. which contemplates running electric cars in the district will also receive energy in bulk from the company's local station.

London.—Bermondsey.—A special meeting will be held on July 17th, to consider a recommendation of the Electric Lighting Committee that application be made to the Board of Trade for a provisional order authorising the Council to supply electricity for public and private purposes throughout the whole area of Bermondsey Borough. The Council has no present powers in the old parishes of St Olave, St. Thomas and St. John, Horselydown.

The L.C.C. has agreed to a loan of £14,761 for electric lighting purposes, conditionally on the B.C. agreeing to provide by special sinking fund or from maintenance account for renewals and replacements of works, plant and machinery provided out of the loan during its currency. The Council agreed to the terms.

St. Pancras.—According to a return circulated on Monday by the Electricity and Public Lighting Department of the B.C., the total number of units sold during the three months ending March 31st last was 2,184,772, of a total value of £21,919, as against 1,856,134 units, valued at £20,384, supplied in the corresponding period of 1905. By far the largest proportional increase in the units sold were those for power, which during the three months numbered 418,251, as against 219,910 in the corresponding period of last year. Application is to be made to the L.C.C. for a loan of £1,011 for arc lamps. The Electricity Committee is to consider an application from the L. & N.W. Railway Co. for permission to lay a pipe under the roadway for the enclosure of electric cables for lighting the Euston Hotel from the company's own power station.

Hackney.—Application is to be made to the L.C.C. for a loan of £900 for the extension of arc lighting. The £4,475 to the credit of the electric lighting reserve fund has been invested in the purchase of L.C.C. 3 per cent. consolidated stock.

Southwark.—The B.C. has decided to disregard the communication of the County of London Electric Supply Co., Ltd., in regard to a supply of energy for street lighting, &c. The company offers to supply energy for public lighting at 1¼d. per unit for a minimum of 200 lamps, and should the Council extend the number of lamps, the company would re-consider this figure.

Lynton.—The U.D.C. has accepted the tender of the E.L. Co. for public lighting for seven years, at 50s. per 32-c.p. lamp per annum.

Motherwell.—The report on the electrical undertaking for the past year, shows a total working expenditure of £3,938, and a revenue of £9,265, leaving a gross profit of £5,327. Financial charges absorb £4,140, leaving a net profit of £1,187 on the year's working. The works costs averaged ·73d. per unit. Owing to this satisfactory result, a reduction in the price of energy for lighting of from 3½d. to 3d. per unit, and also for power purposes, is being considered.

Plymouth.—The Electricity and Street Lighting Committee recommends the T.C. to reduce the price of energy to private consumers from 4d. to 3¾d. per unit, and for power from 2d. to 1¾d., and that a rebate of 1d. per unit be made to private consumers for energy consumed between midnight and 3 p.m.

Portsmouth.—The annual report on the working of the electricity department, shows that the revenue amounted to £51,761, an increase of £6,041; the expenditure was £23,131, a decrease of £1,685, although nearly 400,000 units more were generated, the total output having been 3,841,850 units. The gross profit of £28,630 was reduced by financial charges, &c., to £11,960. The T.C., having discussed the profit of £11,960, has agreed to the devoting of £3,500 to the relief of the urban rate; £4,000 to writing off capital charges incurred in excess of borrowing powers; £1,000 to the Corporation's special fire insurance reserve; the balance going to the reserve fund, which now amounts to £16,825, the capital expenditure standing at £295,036.

The E.L. Committee has recommended the T.C. to appoint an E.L. canvasser and collector, at a salary of £2 per week and commission on new business.

Tunbridge Wells.—In addition to the flat rate adopted by the T.C., and mentioned in the Electrical Review last week, the Council has also reduced the price of electricity for heating and power from 3d. to 2½d. per unit, with a uniform rental for meters at 2s. 6d. per quarter.

(*Continued on page* 967)

THE GILLINGHAM ELECTRICITY UNDERTAKING.

Situated on the outskirts, and, in fact, dependent on one of Britain's best known naval and military centres, viz., Chatham, the town of Gillingham can boast a population of

Fig. 1.—Exterior of the Gillingham New Electricity Station.

nearly 50,000 and the inclusion of several large military and naval establishments in its area. Electricity supply in the district dates from the establishment in Gillingham of a branch generating station by the Chatham, Rochester and District Electric Lighting Co. This branch was bought by the then Urban District Council in 1902, and after the undertaking was taken over, Mr. W. H. Trentham was appointed consulting engineer with a view to remodelling both works and distribution system, a proceeding which ended in the scrapping of the company's plant, which included, among other antiquities, rope-driven Mordey alternators, and Cornish multitubular boilers.

It was also found necessary to construct substantial buildings (shown in fig. 1) adjoining the older works, which continued to supply the area until the change over in December, 1903, to the three-phase generating plant and distribution system adopted by the Council.

This system includes a H.T. supply at 2,000-2,200 volts pressure to nine sub-stations, from which distribution is effected in the older portion of the area at 100 volts, and at 230 volts in the newer portions.

The site of the generating station adjoins the S.E. & C. Railway, a feature which may in time be of considerable utility. The plant installed includes, in the boiler house, two Babcock & Wilcox boilers (fig. 4), each with an evaporative capacity of 10,000 lb. water per hour, and a smaller boiler by the same makers of half the size.

The boilers work at 200 lb. pressure, the steam being superheated 70° to 80° F.; they are fitted with chain-grate stokers, driven by a small steam engine, and the furnace gases pass through a Babcock & Wilcox horizontal tube economiser *en route* to the chimney.

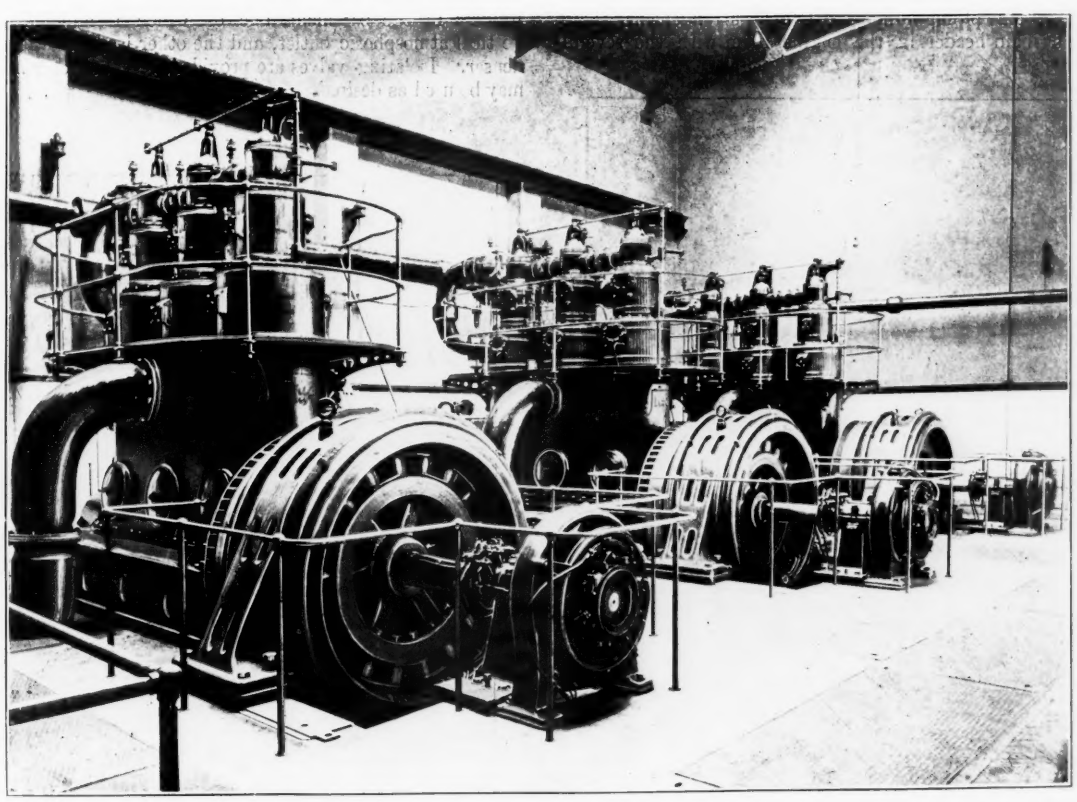


Fig. 2.—General View of the Three-phase Generating Plant.

F

In the boiler house are also installed two Hall compound direct-acting feed pumps, rated at 2,000 gal. per hour each: these are shown in fig. 5; they draw from a Warwick detartariser close by and feed through a Rankin filter and the economiser to the boilers.

The water supply for the station is obtained from a well some 100 ft. deep, and is of an exceptionally hard character.

A Hayward-Tyler three-throw pump, gear-driven from a compound steam engine and mounted over the well, forces the water up into the reservoir under a 1,000-H.P. Klein natural-draught cooling tower situated behind the station; from the reservoir the water for circulating purposes is taken in the usual way and returned to the upper trough of the cooling tower.

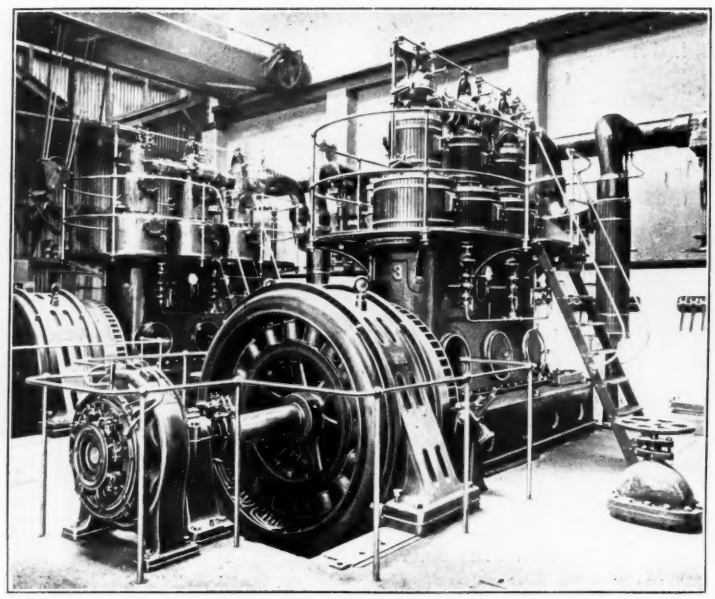


FIG. 3.—A 300-KW. WILLANS-B.T.-H. THREE-PHASE SET.

Hot water for boiler feed purposes is drawn from the trough above mentioned, passing through the detartariser to the pump suctions.

The steam piping follows a simple arrangement, there being a main header in the engine room with the several boiler and engine branches on either side. The generating plant consists of four Willans-British Thomson-Houston units, having a total capacity of 1,575 H.P. These include three 300-KW. three-crank compound engines direct coupled to three-phase alternators generating at 2,000-2,200 volts pressure and 50 periods and with a speed of 333 r.p.m.

The alternators are of the revolving field type, and in each case an 18-KW. exciter is mounted on the end of the main shaft; the excitation being at 110 volts pressure.

A view of the above plant is shown in fig. 2, and of a single 300-KW. set in fig. 3.

There is also a miniature set, installed originally for light load work, and consisting of a 100-KW. two-crank unit of exactly similar type and by the same makers as the larger units; this unit is fixed at the end of the engine room adjacent to the condenser pit, in which Alley & McLellan surface condensing plant of 900 H.P. capacity is installed.

The main engine exhausts branch into two exhaust headers in the basement, one of which terminates in a vertical atmospheric outlet, and the other leads to the condenser. Isolating valves are provided, so that either header may be used as desired.

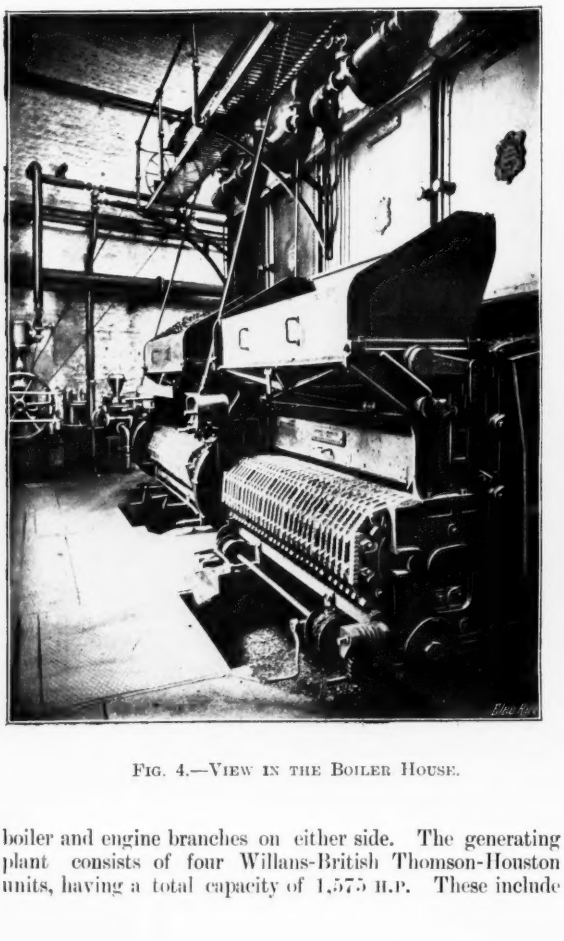


FIG. 4.—VIEW IN THE BOILER HOUSE.

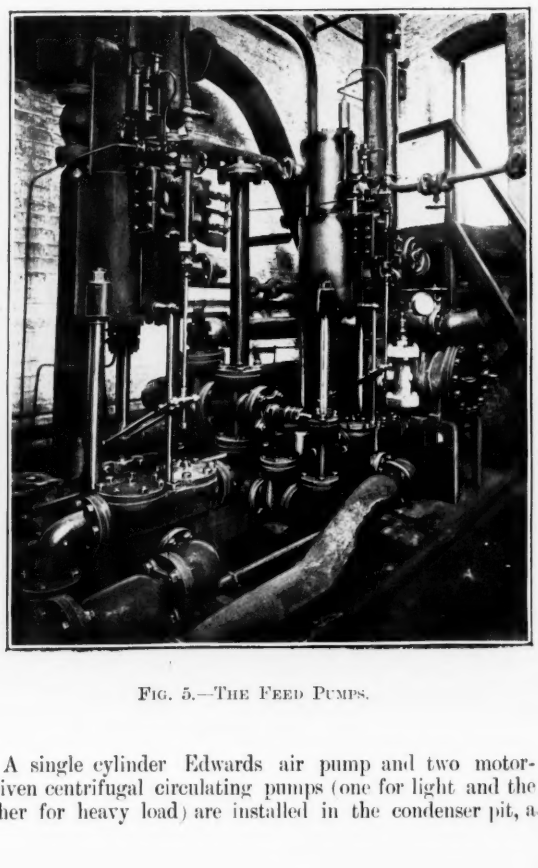


FIG. 5.—THE FEED PUMPS.

A single cylinder Edwards air pump and two motor-driven centrifugal circulating pumps (one for light and the other for heavy load) are installed in the condenser pit, a-

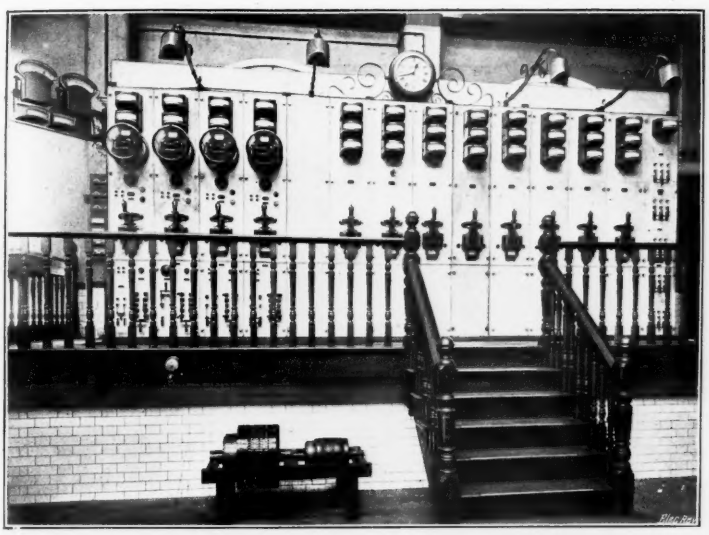


Fig. 6.—The Main Switchboard

Fig. 7.—An Irregular Test: the Sub-Station underneath was Uninjured.

view of which, together with the "baby" unit, is shown in fig. 9. The hotwell water is discharged into the sewers, a Mumford steam pump is provided for this purpose in the boiler house, as the hotwell is below the sewer level. In the engine room basement there are also provided small centrifugal and steam-driven pumps for circulating water through the crank chambers of the Willans engines.

The switchboard, which is shown in fig. 6, is of the B.T.-H. Co.'s standard type, and includes four generator panels with exciter panels below, and eight feeder panels. Oil switches are provided behind the panels, and the bus-bars are arranged overhead with marble isolating divisions.

Instrument transformers are also fitted behind the board, the instruments including ammeters in each feeder phase, and watt-hour-meters on the generator panels. A swinging arm contains main and exciter bus-bar and paralleling voltmeters.

A diagram of the H.T. network is shown in fig. 8. The main feeder panels in the generating station control feeders to West Court, Bellingham, Old Brompton and Gillingham Green, the remaining feeder panels being utilised for the test room and works power and lighting purposes, in connection with which a works transformer sub-station is provided beneath the switch gallery.

As previously mentioned, nine other sub-stations are in use in the area: eight of these are of the underground type, equipped with static plant, and the ninth, situated on Government property adjacent to the Naval Hospital is an ordinary building containing three 50-KW. G.E. Co.'s motor-generators for transforming the H.T. three-phase supply into direct current at 220 volts pressure, some 7,750 8-C.P. lamps being supplied in the institution mentioned.

The H.T. feeders are of the three-core paper-insulated lead-covered type, provided with an outer copper sheath, and are laid solid in earthenware troughing. At each sub-station the feeders are looped in, being connected to banks of 15-KW. B.T.-H. single-phase transformers through Cowans' H.T. switchgear. The latter and the L.T. switchgear are arranged at opposite ends of the sub-station; our illustration, fig. 10,

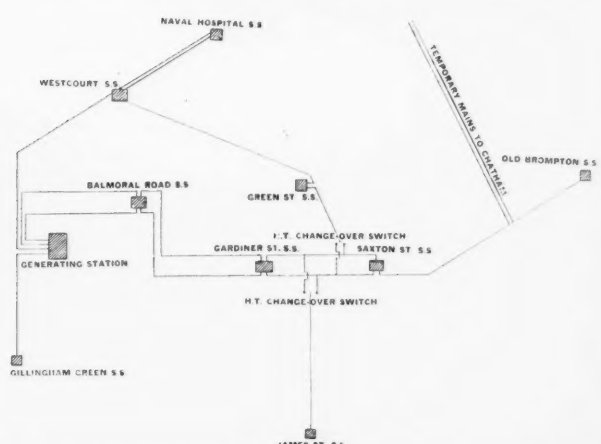


Fig. 8.—Diagram of H.T. Network and Sub-Stations.

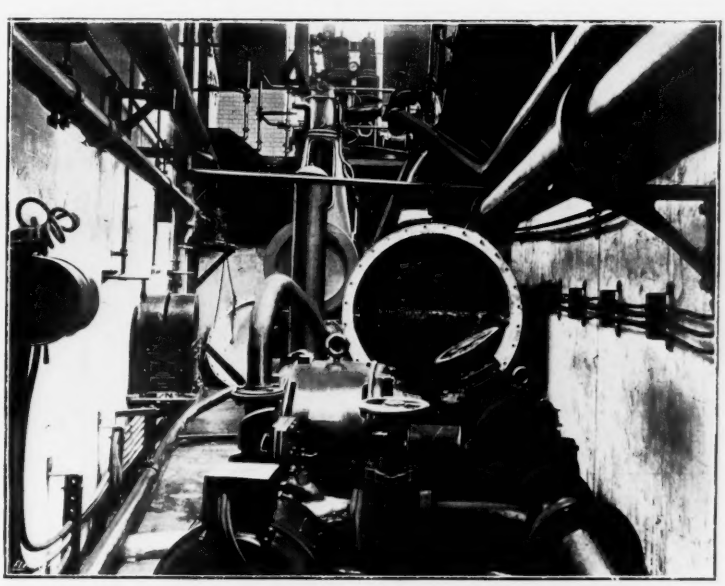


Fig. 9.—View in the Condenser Basement.

shows the transformers and H.T. switches of the Westcourt sub-station, and gives a good idea of the ample dimensions of these chambers, which, being under the road, are necessarily substantially constructed. This latter fact was recently involuntarily demonstrated when a heavy Government traction engine sank into the unsolidified road over one of these structures, without doing any damage, however; this occurrence, which is shown in fig. 7, emphasises the constructional difficulties to be provided for in this class of work.

Fig. 10.—View in the Westcourt Sub Station, showing H.T. Switchgear, &c.

The transformers and neutral points of the generators are earthed, and indicating lamps provided in the sub-stations, give warning if any excess earth leakage takes place.

The L.T. network, fed from the sub-stations, comprises four-core paper-insulated lead-covered distributors, as a rule laid solid in wood troughing, but occasionally armoured and laid direct: also two-core public street lighting mains.

The supply is divided up into two or three circuits for balancing purposes.

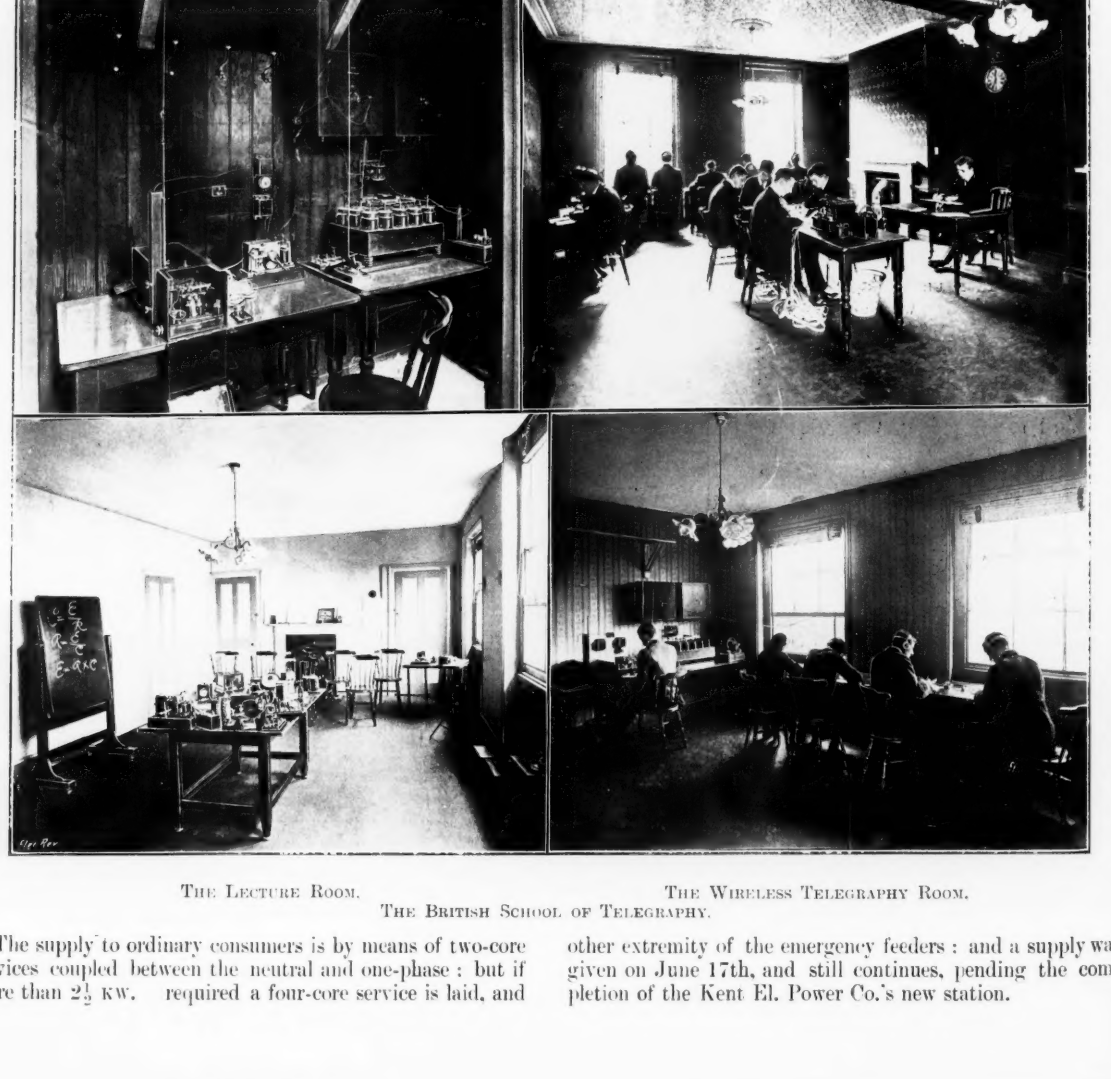
Altogether some 4 miles of H.T., 7¼ miles of L.T. and 7½ miles of street lighting mains are laid.

Our readers will recollect the complete destruction by fire of the old Chatham generating station of the Kent El. Power Co., taken over from the Chatham, Rochester and District El. Lighting Co., which occurred on June 2nd, 1905. The Gillingham Corporation on that occasion stepped into the breach, offering a supply in bulk from the station herein described.

Two H.T. three-core cables were laid a distance of about 1 mile, connecting up the Corporation's network and an old regulating sub-station forming part of the burnt-out power station. With a view to economising time, a spare feeder panel and gear was detached from the Gillingham station switchboard, and temporarily erected at the

The Marconi Cabin.

A View in the Cable Room.



The Lecture Room.

The Wireless Telegraphy Room.

The British School of Telegraphy.

The supply to ordinary consumers is by means of two-core services coupled between the neutral and one-phase: but if more than 2½ KW. required a four-core service is laid, and other extremity of the emergency feeders: and a supply was given on June 17th, and still continues, pending the completion of the Kent El. Power Co.'s new station.

The financial year of the undertaking ended in March last, 1,163,490 units having been generated, of which 913,096 were sold, and these figures compare with 386,363 units generated and 250,437 sold in the preceding year, which, allowing for the heavy temporary demands of the Chatham area, shows a considerable increase in the Gillingham supply. The total working costs, including public lighting charges, but excluding extraordinary expenses and financial charges, amounted to 1·4d. per unit sold during the last complete year.

In concluding, we must express our indebtedness to Mr. Alex. D. Chalmers, A.M.I.E.E., A.M.I.M.E., the borough electrical engineer, who was formerly in charge of the company's branch undertaking which preceded the present undertaking, for his kind assistance in the preparation of this article.

THE BRITISH SCHOOL OF TELEGRAPHY.

The British School of Telegraphy, 179, Clapham Road, London, S.W., was opened on March 6th last for the training of telegraph operators for the submarine cable, wireless and postal telegraph services. Some views of the different departments appear on the facing page. The principal, Mr. William Lynd, is a well-known expert in telegraph matters, and his experience covers a period which includes the days of the old companies and of the introduction of etheric telegraphy. Mr. Lynd is well qualified to teach theoretical and practical telegraphy, and his connection with the Marconi system of signalling has gained him the confidence of the company which bears the name of the distinguished inventor. The British School of Telegraphy is fully equipped with installations of the very latest type of Marconi apparatus (including magnetic detectors) for the special training of young men who desire to qualify for the service of the Marconi International Marine Communication Co., Ltd. Many of the most successful wireless telegraph operators at the present time in charge of Marconi installations on big ocean liners were trained by Mr. Lynd, and judging by the appearance of the wireless department of this school, the principal will be able to supply technical telegraphists to meet the ever-increasing demands of the great shipping companies. The school is well situated in the main road to Clapham and Balham, and is housed in a fine old mansion with a beautifully wooded garden. In the lower class room, which is neatly decorated, heated by gas, and lighted by electricity, students are prepared for the submarine cable service, the instruments employed including Dr. Alexander Muirhead's most recent types. Here the embryo cable operator is initiated into the duties of an employé at a foreign cable station, by Mr. E. Marett, late of the Eastern Telegraph Co. On the first floor is a commodious and well furnished office, and a large class room for advanced "sounder" pupils. On the second floor there is a well-lighted lecture room, where technical instruction is given daily by the principal. Adjoining this is the wireless telegraph room, containing a complete Marconi installation, comprising a 10-in. induction coil, Marconi receiver, tunes A and B transformers, the new self-starting inker, and Marconi's magnetic detector, all manufactured and supplied by Messrs. Marconi's Wireless Telegraph Co. Telephonic headgear enables a number of pupils simultaneously to read the long-distance signals. In the garden at the back of the premises is a facsimile of a ship's cabin with a complete ship installation, an exact counterpart of the one already described. Here the advanced student can make himself familiar with the limited accommodation to be found on board a liner, and nothing seems wanting to complete the illusion, save the motion of the ship! There is every convenience for students, even to a large coach house for the storage of bicycles. By means of a Crypto converter the charging of accumulators is accomplished in a convenient outhouse belonging to the school. There is a nice room for the use of London students who may not wish to go out to luncheon, and the garden is placed at their disposal during the interval between the morning and the afternoon attendances. The school is already in full swing, and its prospects are certainly promising. A very satisfactory arrangement has recently been introduced by the Principal in the shape of a month's trial to prove the aptitude of its pupil for telegraph work. Under certain conditions no fee is charged for the period of probation.

LIGHTING and POWER NOTES.

(*Concluded from page* 962.)

St. Helens.—The income of the electricity undertaking for the past year was £18,772, and the gross expenditure £17,449, leaving a balance of £1,323, of which £500 has been placed to the credit of the plant and machinery account, and £100 to the accident fund account, leaving £723, which has been carried to the reserve fund.

Salford.—The T.C. has applied to the L.G.B. for sanction to borrow £7,720 for extensions at the Frederick Road generating station, and an inquiry into the matter was held on June 13th.

Sheffield.—The annual report of Mr. Fedden on the electrical undertaking, dealing with the past year's work, has been issued. From it we gather that there is a continuous increase in the number of consumers of energy for light, heat and power and in the output for all purposes. In addition to new consumers, many old ones have increased their apparatus and demand in the course of improving and enlarging their premises, and by adopting electric heating, lifts and power generally. The success of the motors now so largely used in every trade of the city, and the improvement of business generally, have led to an increased interest on the part of the local manufacturers in electric driving and lighting, which has resulted in many orders to the department and private contractors, for electrical plant. During the past year the additions to capital account have been small, and the amount borrowed on behalf of the department has not exceeded £5,440. Mr. Fedden suggests that, in order to hasten the financial success of the department, it is important that it should be entrusted with the light and power supply to every municipally controlled building, and also with the illumination of the principal thoroughfares of the city.

The total capital expenditure at March 25th, 1906, was £839,036. The revenue for the year amounted to £61,972; the working expenditure to £16,888, and the gross profit to £45,084. Financial charges absorbed £46,459, leaving a deficit on the year of £1,375. The accumulated surplus of the undertaking, however, after allowing for this, stands at £18,977. A table giving a comparative statement of the cost of generating and distributing the unit of energy at Sheaf Street and Neepsend shows that the total output in 1904-5 was 4,546,141, as against 5,188,945 in 1905-6. The reduction in the cost per unit, which was anticipated in 1905, has now been fully realised by the continuous running of the Neepsend works, on day and evening load, during the year. The very low generating costs secured with that plant has reduced the average works cost from ·64d. to ·55d. per unit, or 14 per cent., and the average total cost from ·86d. to ·75d. per unit, or 12·8 per cent. A reduction in the price of current for heating and cooking, which came into force in January last, resulted in a greatly increased use for these purposes—in the use of electrical energy for power purposes, and the rapid and uniform increase in the various classes of apparatus connected with the supply mains. There has been set aside out of revenue for the redemption of debt, a total of £73,248, and in addition thereto motors amounting to £2,200 have been purchased out of earnings. For the year 1904, before the new power house at Neepsend came into operation, the total output was only 3,980,049 units, sold at a total cost of production, including all charges, of £17,234., or 1·04d. per unit. For the year ended March 25th, 1906, after 12 months' full working at Neepsend, the total output was 5,188,949 units, at a total cost of £16,306., or ·75d. per unit, or a total saving of £928, with an increased output of 1,208,896 units. On the coal bill alone there has been a saving of £1,356. This is referred to as very satisfactory, as compared with Liverpool, with an output of 31,452,323, including a good load factor consisting of public and private lighting and power for the tramways, the total cost of production for this huge output being the same as at Sheffield, viz., ·75d. per unit.

South Africa.—Transvaal.—The report of the general manager of the Central South African Railways for the year ending December 31st, 1905, covers a report dealing with the electric power branch, which states that the work of the branch "has proceeded satisfactorily during the year without any serious breakdown of plant . . . . The total number of units used during the year amounted to 1,711,574, or an increase of 455,818 over 1904. The use of meters for all departments was sanctioned in September. When these are all installed, it will be possible to obtain very accurately the relative consumption of each department. The capital cost of the branch, including boilers, engines, dynamos, motors and other electrical plant, but exclusive of buildings, is estimated at the end of the year to be £51,705."

King Williamstown.—Recently additional machinery for the municipal electrical plant was opened by the Mayor, Mr. J. Ginsberg. The duplication was rendered necessary by the increased demands for energy.

Southport.—The Electricity Committee of the T.C. has decided to convert the arc lamps on the Promenade to flame lamps, at a cost of £485.

Stalybridge.—A net deficiency of £15,695 is reported by the Stalybridge, Hyde, Mossley and Dukinfield Joint Tramways and Electricity Board for the past year. The board has paid £2,500 in rates to the boroughs during the year. The total receipts were £32,673, and the working expenses £28,228. The net loss on the tramways was £9,612.

Stockport.—A sub-committee has been appointed to consider the question of public lighting by electricity, the proposal being to add 50 5-ampere lamps.

Swansea.—The past year's working of the electrical undertaking shows a total revenue of £16,097, compared with £12,918 in the previous year. The working expenditure amounted to £8,199, leaving a gross balance of £7,897 and a net profit of £399, after meeting financial charges, &c. The net profit was devoted towards reducing the previous year's deficits, amounting to £1,477.

Walmer.—Messrs. Foote & Milne have informed the U.D.C. that they considered that it would be worth their while to take over the E.L. order possessed by the Council, and suggested that as security, the firm should deposit £1,000 and expenses to bankers and others. They estimated the initial cost at from £12,000 to £15,000, the charge for electricity would be 5d. or 6d. per unit, with better terms for street lighting. The E.L. Committee considered the security suggested was insufficient, and suggested that a guarantee of the due payment of the sinking fund and interest extending over the full period of the loan should be obtained, but Mr. Foote replied that he thought the guarantee premium on a risk of this kind would overload the working expenses. The Committee decided that if its requirements as to security were fully met, it would be prepared to concede something on another point, for instance, by deferring power to take over the works until an agreed profit had been made, while the Council might be prepared to sell the order outright on payment of the expenses incurred, and the safeguarding of the Council's interests. These suggestions are being considered by the firm.

Warrington.—The L.G.B. has sanctioned a loan of £7,000 for E.L. purposes, and has intimated that before sanctioning a further loan for prospective expenditure on cables and services, it will require to be furnished with a statement showing how the loan now sanctioned has been expended, and a map showing the streets in which the mains have been laid.

Westhoughton.—The U.D.C. has decided to withdraw its opposition to the Bill of the Lancashire Electric Power Co., on being given an undertaking that the company will not supply energy in the district without the Council's consent.

Worcester.—The T.C. has decided to supply energy at 1½d. per unit between May 31st and August 31st to all new customers who apply during that period.

TRAMWAY and RAILWAY NOTES.

Bradford.—The financial statement of the Corporation tramways for the year ended March 31st last, shows a traffic revenue of £220,146, being £3,395 less than the preceding year. The total income was £228,977. The amount carried to reserve and renewals account (practically the profit for last year) is £11,637, as against £15,929 in the preceding year. The expenditure on capital account to the end of the last financial year is £906,818.

Burnley.—The T.C. has decided to ask the sanction of the B. of T. for power to run its electric trams at 16 miles per hour, instead of 12 as at present. There was opposition from a section of the Council, who contended that the Corporation ought to be summoned for exceeding the present limit.

Canada.—BRITISH COLUMBIA.—The Canadian Westinghouse Co., of Hamilton, Ontario, has just completed the largest electric generator ever made in Canada. It has been shipped to the order of the British Columbia Electric Railway Co., and is the fourth supplied, the other three having been furnished by the Pittsburg firm before the Canadian Westinghouse Co. was organised. The equipment which the company has sent to British Columbia consists of one generator, 2,000 H.P., three-phase, 200 r.p.m., engine type, revolving field for direct connection with water-wheel; one rotary converter, 1,350 H.P., 500 volts, three-phase, 400 r.p.m.; eight air-blast transformers, each 733 H.P., 2,200 volts to 24,200 volts, 7,200 alternations; also the necessary switchboards, regulating and controlling devices.

WINNIPEG.—On May 30th, in the presence of a representative gathering of Winnipeg business men, Sir David McMillan turned on the power at the Winnipeg Electric Street Railway Co.'s great plant on Pinnawa Channel, Winnipeg River. The plant is located 60 miles from Winnipeg, and is capable of developing 10,000 H.P., which will be transmitted to Winnipeg for the company's street railway system, and for lighting and manufacturing purposes, and will enable them to practically cut their former charges in half.

Chesterfield.—In his annual report Mr. R. L. Acland states that the total capital expenditure for the tramways undertaking has been £70,842, the total revenue for the year has been £10,865, and working expenses £5,526; interest and sinking fund absorb £3,873, and there is a net balance of £1,466, which has been appropriated as follows:—Preliminary expenses £338, part cost of promotion £400, reserve fund £728. 269,981 car-miles have been run and 2,195,956 passengers carried. The average journeys per head of population of the area served, numbered 58. The total revenue per car-mile was 9·6d., and the total operating costs 4·9d. per car-mile.

Colchester.—The report of the Tramways Committee for the year ending March 31st last was, briefly, as follows:—Traffic expenses, £3,239 18s., or 2·423d. per car-mile; general expenses, £925, or ·691d. per car-mile; general repairs and maintenance, £1,211, or ·906d. per car-mile; cost of energy at 1½d. per unit, £2,817 18s., or 2·107d. per car-mile; total operating expenses, 6·127d. per car-mile. The year's income amounted to £10,588, or 7·916d. per car-mile. Of the cost of maintenance, £955 odd was in respect of cars, and £185 for electrical equipment. The total amount of deficiency since the commencement of the undertaking (no allowance being made for depreciation) was stated to be £532 14s., which was recommended to be defrayed by the rates.

Continental Notes.—SWITZERLAND.—The trials which are being carried on by the Maschinenfabrik Oerlikon, Zurich, with high pressure single-phase current on the line Seebach-Wettingen, have made good progress. The Swiss Federal Railway authorities carried out official tests on the section between Affoltern and Regenstorf, and the regular running of trains now takes place up to the latter station. The work on the section Regenstorf-Wettingen is also being rapidly pushed forward. As soon as the whole line is finished, an express locomotive of about 1,000 H.P. normal capacity, such as the electrification of the line Zurich-Lucerne would necessitate, will be brought into service. From January 15th, 1905, to May 1st, 1906, 2,360 runs of 4,700 train-miles were made. The two electric locomotives of the Maschinenfabrik Oerlikon have given satisfaction during the whole of the time. The newer of the two (since November 10th, 1905, in regular service) is equipped with single-phase motors of 250 H.P., which are said to be the only ones existing with this output.

ITALY.—The Italian *Gazetta Ufficiale* of May 29th contains a copy of a law authorising the "Societá Romana Tramways-Omnibus" to double the existing electric tramway line between the "via Nazionale" and the "viale Manzoni."—*Board of Trade Journal.*

Croydon.—An unusual position has been created by the transference of the Croydon tramways, through the falling in of the lease, from the B.E.T. Co. to the Croydon Corporation. The Penge tramways, which belong to the B.E.T. Co., and which carry the South Norwood line on to the Crystal Palace and Penge, have been practically isolated; and, as the parties cannot come to terms and arrange a through service, all the cars stop at the Penge boundary. At the other end of the line the Mitcham tramways, which carry the line on to Tooting and Sutton, have also been isolated, the Croydon portion of the rails which run from South Norwood to West Croydon coming in between. If the Corporation and the company cannot come to terms, it is expected that the B.E.T. Co. will go to Parliament and endeavour to get running powers over the intervening portion of the line.

Edinburgh.—The Tramways Committee will recommend the T.C. at its next meeting to send a large deputation to inspect electric tramway systems on the conduit or surface-contact systems at various towns in England.

Erith.—The revenue account of the tramway undertaking for the period ended March 31st last, shows that the total expenditure over income after meeting loan charges is £160 14s.

The Highways Committee of the L.C.C. has intimated that it hopes to arrive at an early decision in reference to the construction of the authorised tramways between Woolwich and the county boundary at Abbey Wood, which will link up the Erith system to the L.C.C. tramways.

Farnworth.—The U.D.C. has decided to support the application of the South Lancashire Tramways Co. for running powers through Clifton.

Folkestone.—The T.C. has applied to the B. of T. for a further extension of the Tramway Order.

Glasgow.—The Tramways Committee of the T.C. have decided not to proceed meantime with the extension through Thornliebank to Pollokshaws.

In consequence of the serious competition of the tramways with their suburban traffic, the Caledonian Railway Co. have made considerable reductions in their ordinary and season ticket rates.

Lancaster.—At a special meeting of the T.C. the tramways question was considered, the point involved being whether an offer from Messrs. Kershaw, of Birmingham, representing a syndicate desirous of leasing the Lancaster electric trams, should be accepted. The Tramways Committee recommended the Council not to entertain the offer, but to empower the committee to re-open negotiations respecting the sale of the Lancaster to Morecambe (horse traction) tramways. According to Ald. Smith, the chairman of the Tramways Committee, the idea of the committee was not to purchase the line themselves but to give facilities in the form of an extension of lease to a company, who might take over the Morecambe route and electrify it. In return for the concessions

by the Corporation, the latter would demand running powers to Skerton (the first mile of the line to Morecambe), and then continue branch feeders to Skerton Park and Beaumont Bridge.

London.—St. Pancras.—The Highgate Hill Tramways, Ltd., have informed the B.C. that they intend to apply for a Parliamentary Order for the construction of light railways.

L.C.C.—An important extension of tramway facilities in South London has been made by the L.C.C., which is now running through cars from Westminster Bridge to Rushey Green and Catford, passing through Camberwell, Peckham, New Cross and Lewisham. The new route is the longest over which the Council's cars are at present running, and 4d. has been fixed as the through fare from Westminster or Catford, a distance of about seven miles. It is expected that the new line from Tooting will be opened as far as Earlsfield in a few days' time.

Luton.—A deputation of the T.C. has recently visited Lincoln to inspect the working of the G.B. Surface Contact Tramways there installed. The Lincoln Corporation officials expressed their great satisfaction with the system, which during the past six months' running has more than fulfilled expectations. This system has been referred to on several occasions in our pages.

Nottingham.—The tramway returns for the year ended March last are of a very satisfactory character; a net profit of £20,000 has been earned, £15,000 of which is to be devoted towards the reduction of the general district rate. The total income was £129,748, an increase of £3,418 as compared with the previous year.

Nuneaton.—The B. of T. has declined to grant a further extension of time for carrying out the Nuneaton and District light railway scheme.

Poole.—The Railways Committee of the T.C. has reported with reference to the question of workmen's fares, that the Bournemouth Corporation was advised that the Poole Corporation could not require it to extend to the Poole and District Light Railways the system of ½d. fares adopted in Bournemouth. It was decided to draw attention to the terms of the agreement entered into when the light railway purchase was arranged, and to ask the Bournemouth Corporation to observe the terms thereof in respect of fares charged.

Rochdale.—The working expenses of the Corporation tramways during the past year amounted to £23,767, and after meeting all expenses an adverse balance of £300 remained. The number of passengers carried was 7,695,745; the average working expenses per car-mile, including power cost, were 5·8d.; and the total revenue averaged 10·23d. per car-mile. The gross capital expenditure on the system amounted to £328,024.

South Lancashire Tramways.—Messrs. Krauss & Son, of Bristol, have now laid about three more miles of lines for the Lancashire United Tramways Co., viz., from Brookhouse to Farnworth, Walkden and Swinton, and have just started another section from Boothstown to Worsley.

Southport.—Additional information to that published in the Electrical Review on June 1st, concerning the past year's working of the Southport Corporation Tramways is now available. The total traffic and other receipts (excluding rent, &c., from the Southport Tramways Co.) for the year amounted to £17,230, against £17,691 for the previous year, a decrease of £460 14s. The tramways were opened in 1900, and for the first year the receipts were £7,568; the working expenses, £5,476; the gross profit, £2,091; leaving a net balance (profit) of £81 5s. Last year the receipts were £17,230, the working expenses £10,760, the gross profit £6,470, and the net balance (deficit) £654 14s. The following paragraph in the manager's report revives a vexed question locally:—"To show how very dependent the tramways are on visitors to the town, I would point out that during seven months of the year the cars are run at a loss. If the tramways are to be a financial success, the question of Sunday running will have to be carefully considered in the future. The interest and sinking fund charges amount to £7,135, and the two items alone cost us £19 10s. per day, taking the year through, and as the cars do not run on 52 days of the 365 (which is the usual number for tramways), this is equivalent to paying a rent of £1,014 whilst the undertaking is idle."

The number of passengers carried during the year was 3,874,610, a decrease of 7,246. The traffic receipts per passenger were 1·05d., or ·03d. less than in the previous year. The best paying routes were those through the working class districts.

There is now a deficit on the estate of £981 13s.

Sunderland.—The Sunderland and District Tramway Co. has from June 11th contracted to carry the mail bags from the post offices on the route of its tramways to Fencehouses station. The company has also instituted a successful parcel service.

Swansea.—At a recent meeting of the Corporation Tramways Committee it was decided to recommend the Corporation to give notice to the Tramways Co. of intention to purchase the tramways authorised by the Act of 1882. This applies to the section from Alexandra Road to the docks. With respect to the sections recently constructed by the Corporation and leased to the Tramways Co., it was reported that the cost of construction on which the rental basis is to be fixed, has been agreed at £108,363.

Warrington.—The gross profit on the tramways undertaking for the year ending March 31st last, amounted to £6,296, and after meeting financial charges there remained a net profit of £473, as compared with £450 in the previous year. The working expenses amounted to 6·75d. per car-mile, and the receipts to 10·16d. per car-mile, both items showing an increase on the previous year.

Willesden.—The U.D.C. has decided to join with about 50 other local authorities to have the decision of the Divisional Court in the case of the Wakefield Corporation *v.* the Wakefield and District Light Railway Co. reviewed by the Court of Appeal. The question at issue is whether light railways should be rated on the full annual value thereof, or on one-quarter of the full value.

TELEGRAPH and TELEPHONE NOTES.

Asiatic Turkey.—The Ottoman Administration has sent to the *Journal Télégraphique* a long statement, with a request for insertion, dealing with the inauguration of a duplicate direct wire between Constantinople and Fao. In order to avoid the difficulties of maintenance of the old route, the new wire has been laid *viâ* Konia, Adana, Alep, Deir and Bagdad, instead of *viâ* Angora, Diarbekir, Moussoul and Bagdad.

Australia.—According to the *Elektrotechnische Zeitschrift*, the Australian Government has commenced the laying of a copper telephone line between Melbourne and Sydney, the length being 800 kilometres.

Hampstead Telephones.—The B.C. having refused to grant permission for the erection of an overhead telephone line in Ornan Road, the Postmaster-General has written referring to the general question of the erection of pole lines in Hampstead and to the heavy expense to the State of underground lines, and suggesting that a suitable proportion of such work should be borne by the Council, who at its own cost, should open the roads, excavate and fill in the trenches, and reinstate the surface, the Postmaster-General providing the pipes, cables, &c.; or as an alternative would accept a consent for a pole line in Ornan Road on condition that if at any time more than 16 subscribers are obtained, the wires will be placed underground, the overhead line being then taken down, except a few poles necessary for distribution purposes.

London.—St. Pancras.—The solicitor of the General Post Office recently forwarded to the Borough Council a notice requiring it to consent within 21 days to the erection of telegraph posts in Granby Street, and stating that should the Council not accede to the application, the Postmaster-General would forthwith apply to a stipendiary magistrate to hear and determine the matter under the Telegraph Act, 1878. The Council has replied to the effect that the erection of the posts would be an obstruction to traffic, and that it was in the public interest that the wires should be placed underground. Therefore it could not accede to the Postmaster-General's request, and would appear legally before a stipendiary magistrate should the Postmaster-General apply to same.

Mexico.—The *Elektrotechnische Zeitschrift* states that the Mexican Government has chosen the "Telefunken" system of wireless telegraphy, and has given to the German Wireless Co., at Berlin, the order to connect up Mazatlan and San José del Cabo, the distance being 325 kilometres. It is expected that the number of stations will very shortly be largely increased.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 18, 1902	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Tarifa-Tangier	Jan. 18, 1904	
Cayenne-Paramaribo	April 20, 1906	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Bachkale-Deliman	Feb. 12, 1906	

Wireless Telegraphy in India.—As showing the growing popularity of wireless telegraphy in India, it is interesting to note that during the month of April, 328 messages were sent from, and 363 messages to Port Blair by wireless telegraphy; 170 messages were exchanged at Slipper Island, and out of the total of 861 messages, 366 were classed as private. Communication was maintained throughout the month, but it was imperfect on 11 days, and was interrupted on afternoons of eight days, owing to the atmospheric disturbances.

CONTRACTS OPEN and CLOSED.

OPEN.

Brynamman.—June 20th. Street lighting extensions for the B. and District Electric Supply Co., Ltd. See "Official Notices" to-day.

Chorley.—June 18th. Electric light installation at the refuse destructor works for the Corporation. Specification from Mr. O. Hansom, electrical engineer, Albert Square, Fleetwood. (21s. deposit.)

Dartford.—June 19th. Oils, meters, cut-outs, cable, general stores for one year for the Council. See "Official Notices" June 1st.

Edinburgh.—June 25th. Lead-covered cables for the Corporation. See "Official Notices" to-day.

Erdington.—June 27th. Tramway overhead equipment for the U.D.C. See "Official Notices" June 8th.

Finchley.—June 18th. Mains, network and joint boxes, &c., for the U.D.C. See "Official Notices" June 8th.

Luton.—June 15th. Cables for the Corporation. See "Official Notices" June 8th.

Manchester.—June 19th. D.C. motors, motor-starters, meters, service cables, fuse-boxes, bitumen and box compound, for the electricity department. See "Official Notices" June 8th.

Manchester.—June 19th. Trolley wire for the Tramways Department. Specifications, &c., from the tramway manager.

Portsmouth.—June 27th. Water softening plant, tank, piping, &c., for the T.C. See "Official Notices" to-day.

Rotherham.—June 30th. Cables and meters for one year for the Corporation. See "Official Notices" to-day.

Salford.—June 22nd. Four direct-current motors (1, 15 and 40 B.H.P.) for the Royal Technical Institute. See "Official Notices" June 8th.

Spain.—June 29th. Electric lighting of the town of Gibraléon, at the upset price of 4,971 pesetas (about £183) per annum, in accordance with conditions set forth in the *Gaceta*. A deposit of 273 pesetas (about £10) is required to qualify any tender. —*Board of Trade Journal.*

Spain.—The municipal authorities of Revenga (province of Palencia) have just invited tenders for the concession for the electric lighting of the town during a period of 13 years.

Spain.—The Spanish Post and Telegraph authorities in Madrid have just invited tenders for the supply of 12,000 metres of telephone cable and 12,000 metres of telegraph cable.

Stepney.—June 18th. Flame arc lamps and columns for the B.C.; also meters, demand indicators, and carbons. See two "Official Notices" June 8th.

Stoke-upon-Trent.—June 18th. Piping for the Electricity Committee. See "Official Notices" June 8th.

Wallasey.—July 16th. A.C. transformers for the U.D.C. See "Official Notices" to-day.

Wimbledon. — June 20th. 12 Flame arc lamps and columns for the Corporation. See "Official Notices" June 1st.

CLOSED.

Brighton.—The T.C. on June 7th accepted the tender of Messrs. Babcock & Wilcox, Ltd., for the supply of a stand-by induced draught apparatus for the Southwick station, at £2,080.

Bradford.—The Corporation Tramways Committee has accepted the tender of Messrs. Bolckow, Vaughan & Co., Ltd., of Middlesbrough, for the supply of 500 tons of steel girder rails, at £3,393 15s.

Derby.—The T.C. has contracted with Callender's Cable Co. for the supply of cable extensions, at £662.

Glasgow.—The Tramways Committee has accepted the following offers:—

Distribution fuseboards for steel conduit wiring.—Simplex Steel Conduit Co., Ltd.
Old copper cable.—W. T. Glover & Co., Ltd.
Private telephone lines.—Corporation Telephone Department.
Parkinson vices.—Dempster, Moore & Co.
Carbons required up till May 31st, 1907.—One half to the Sloan Electrical Co., Ltd., instead of to Messrs. Crompton & Co., Ltd., as formerly arranged.
Induced draught fans for St. Andrew's Cross station.—Musgrave & Co., Ltd., at £615.
Induced draught fans for Port Dundas station.—Musgrave & Co., Ltd., at £505.
Two pairs of their patent direct-acting feed pumps for the Port Dundas and St. Andrew's Cross stations.—G. & J. Weir, Ltd., at £285.
Ventilating fans, motors, ducts, &c., required at the Dalmarnock sub-station.—Musgrave & Co., Ltd., at £118.

Tenders have been accepted by the Electricity Committee for the erection of the new sub-station at Springburn.

France.—The French Post and Telegraph authorities in Paris have just placed contracts as follows:—Messrs. Geoffroy and Delore, of Clichy, 160 kilometres of single conductor tel-phone cable, at 620 fr. per kil.; M. de la Mathe, of St. Maurice, 35 kilometres ditto, with 14 conductors, at 1,968 fr. per kil; and M. Grammont, of Pont de Cheruy, 26 kilometres ditto, with 56 conductors, at 4,250 fr. per kil.

Gravesend.—The T.C. on June 6th accepted the following tenders:—

Siemens Bros. & Co., Ltd.—Switchboard, £360, with £25 extra for a Groves test panel.
Mirrlees Watson Co., Ltd.—Condensing plant, £746; feed-heater, £98; and welded pipes, £42.
Chloride Electrical Storage Co., Ltd.—Highfield automatic reversible booster, £321.

Halifax.—The T.C. has accepted the tender of Mr. R. Turner, of Halifax, for the supply of 12 roof covers for tramcars, at £68 10s. each.

London.—ST. PANCRAS.—The B.C. received the following tenders for the annual supply of carbons:—

H. Tuchman	£575	Mayer & Co.	£723
Geipel & Lange .. (accepted)	581	Johnson & Phillips, Ltd. ..	732
Pestalozzi & Co.	608	" " (alternative)	668
International Electric Co. ..	609	General Electric Co.	750
Compagnie Francais	617	Sun Electrical Co.	750
G. Braulik	640	Electrical Co.	872
Crompton & Co.	646	E. H. Cadiot & Co.	878
Sloan Electrical Co.	715	Siemens Bros. & Co.	903

HACKNEY.—The B.C. received the following tenders for positive accumulator plates with which to renew some of the cells of the Tudor battery, the prices being based on an agreement that the material of the old plates be at the disposal of the firms supplying the new ones:—

	Per plate.
Chloride Accumulator Co.	9s. 5d.
Electrical Power Storage Co.	10s. 10d.
Tudor Accumulator Co. .. (accepted)	12s. 0d.
"D.P." Battery Co.	14s. 5d.

The plates are to be delivered in lots of 25, and the quotations were given on an estimated consumption of about 250 plates per year.

Rotherham.—The T.C. has accepted the following tenders in connection with the Whinney Hill tramways:—

Ibbotson Bros. & Co., Ltd.—Tie-bars, bolts and nuts, £107.
British Insulated & Helsby Cables, Ltd.—Trolley wire.
Naylor Bros., Ltd.—Bracket arms.

Roumania.—The Société d'Eclairage Electrique, of Paris, submitted the lowest tender (£12,772) for the erection and equipment of a central electric lighting station in the town of Turn-Severin.

FORTHCOMING EVENTS.

Tuesday, June 19th to 23rd.—Municipal Electrical Association meetings. (See page 849 ELECTRICAL REVIEW, May 25th, for programme.)

Friday, June 22nd.—At 5 p.m. Physical Society. Mr. A. A. Campbell Swinton on "The Effect of Radium in Facilitating the Visible Electric Discharge in Vacuo"; Mr. A. O. Allen "A Comparison Between the Peltier Effect and other Reversible Heat Effects"; Mr. T. A. Vaughton "The Effect of the Electric Spark on the Activity of Metals"; Dr. P. E. Shaw on the "Dielectric Strength of Thin Liquid Films"; Dr. W. H. Eccles "The Effect of Electrical Oscillations on Iron in a Magnetic Field."

Saturday, June 23rd.—Foreign visitors arriving.

NOTES.

Electric Shock Fatality.—We briefly recorded last week the death of an employé at the works of Messrs. Callender's Cable Co., at Erith, the cause being electric shock. The evidence given at the inquest showed that deceased was found in a doubled-up position, clinging to a drum of cable. He was still breathing, and artificial respiration was employed, but he died a quarter of an hour later. There was no current on the cable at the time. The floor was wet.

Mr. H. Goddard, electrician at the works, said deceased was engaged in putting into or taking out of the tank cables which were being tested. The drums on which the cables were wound were put into the tank, and pulled out by an electric crane. Witness was making connections to carry out a high-pressure test. Witness warned three men, including deceased, to "clear out," as the pressure was about to be put on. After warning them, he went up to the box and made the necessary connection, and switched on the boxes. There was no current on then. He noticed at that point that the three men had obeyed his instructions, and had cleared away. Witness took another look to satisfy himself that all was clear before giving the signal to the switchboard attendant for the current to be applied. He went to his desk, and after looking at something there, went up to the pressure room, and had read the voltage, when he noticed a sudden rush of current. At first witness was under the impression that one of the cables had given out, but this was not so. He thought the cable from the

pressure box into the section which they were testing for pressure had given out. Later investigation showed a small hole in the cable about the size of a pin's head. He could not account for deceased being found in the position described by Keeve, as the last time he saw the three men they had obeyed his warning and got out of the danger zone. Deceased had no right, after having been warned, to be in the section in which he was found. The men were not tightening up the cable on the drum; he was sure of that. Asked if it would be possible for a person to get a shock strong enough to kill him through the leakage discovered, witness said it was impossible to say. It would depend on the state of a man's health. Deceased was very careful, and one of the best men they had.

Walter Jackson said he was working with deceased and Sutton on the afternoon in question. When the warning was given by the previous witness he thought they had just time to finish tying a cable they were engaged upon, and he and deceased did not go out of the danger zone at the very instant they were told to. Had they gone immediately on being warned by Mr. Goddard they would have got clear. But he and deceased stayed to finish tying the cable. What they were doing then had nothing to do with the test that was being conducted. There was a flash, and witness received a slight shock. Deceased was on the opposite side of the drum at the moment.

Dr. Maynard said he most carefully examined the body from head to foot, and found no mark, bruise, burn, or discoloration, or indication that deceased had received a serious electric shock. Nor was there any such mark on his clothing. The blood was dark coloured and thin, and there was abnormal congestion of all organs. The heart was unusually large and dilated, with much fat about it. There was valvular disease; also signs of chronic inflammation beyond the state of the blood and general congestion. Nothing was disclosed by the examination to support the hypothesis that deceased was killed by electric shock, either internally or externally. But, after hearing the evidence, and taking into consideration the condition of the heart, witness was of opinion that death was caused by heart failure, the result of an electric shock; and, whether that shock was slight or whether it was severe, the condition of his heart would materially conduce to a fatal result. In all cases of death from lightning or electric shock the internal indications were very slight, though the blood was very thin and very dark. He attributed the congestion of the organs to shock to some extent.

The Coroner, in summing up, said that two of the drums had been completed, and the men were at work on the third drum, which only wanted tying at the end to complete it. But, according to the evidence of Mr. Goddard, a further test of other drums was going to be made in a tank higher up. For that purpose a cable ran from the switch-house and led to the cables in the tank which were going to be tested. Before giving instructions to switch on the cable he (Goddard) warned the men. The danger boards were in position. Goddard said the men disappeared from his view, and a second time he looked to see that all was clear. The "lead," or cable in question had been tested up to 30,000 volts, and frequently used up to 20,000. But on this occasion 8,000 volts only were registered. After it had been switched on there was a flash. Since then the "lead," or cable had been taken out, and a small leakage, about the size of a pin's head shown to exist. Whether that got on to the drum by any means there was no evidence to show. But there was a flash. Probably had deceased been a healthy man the shock would not have been sufficient to cause his death. As a matter of fact, the man who was working with him had told them he had a shock, and he was now all right. The Inspector suggested that it would be well to raise the danger boards used. The drums were 6 ft. high, and it was possible that the men would be obscured from Mr. Goddard's view. All reasonable precaution seemed to have been taken. A verdict of "Accidental death," in accordance with the medical evidence was returned.

Electric Signalling Breakdown.—Consequent upon a breakdown of the electrical signalling apparatus at the new Victoria Railway Station, considerable delay has been experienced this week by travellers on the Brighton and South Coast line.

Electricity for Ventilating and Cleansing Sewers.—A conference of representatives of five of the borough councils of South-Eastern London, was recently called at the Greenwich Town Hall, to consider the question of the ventilation of sewers, the subject having been brought prominently forward in connection with the two main sewers (11 ft. 6 in. barrel) now being constructed by the London County Council from Catford and Deptford to Crossness, and great uneasiness being felt throughout the districts intersected at the prospect of having these sewers ventilated by surface ventilators, particularly in the neighbourhood of Blackheath and Greenwich, the plans showing six surface ventilators on Blackheath Common, and two in Greenwich Park.

At the meeting of the conference on the 8th inst., under the chairmanship of the Mayor of Greenwich, after other matters had been disposed of, Mr. Councillor John M. Stone (Greenwich), moved a resolution to the effect: "That in the opinion of this conference the time has arrived when further investigation and experiments should be made as to the best methods of ventilating sewers and dealing with and treating the gases and effluvia generated therein, and that the London County Council be requested to undertake such investigation and experiments, including the consideration of electrical methods of dealing with the same, and that they be requested to receive a deputation of five members of this conference to lay the matter before them."

In the course of his remarks, he contended that the subject of sewer ventilation had made little progress during the last 30 years, and that the time had come when the matter should be put on a scientific basis. He urged the application of electrical science to the subject. Electrical fans were admirably adapted to the work of ventilating, and, as was well known, a high-tension discharge of electricity in air produced ozone and nitrous acid, both powerful deodorisers. Ozone if generated in proper quantities would destroy germs, organic compounds containing sulphur, amines, sulphuretted hydrogen, and other deleterious gases and effluvia. A letter from Major Cardew, the well-known electrical expert, was read, in which he expressed the opinion that it would be worth while trying the effect of high tension discharge of electricity to purify the gases.

Mr. Stone further dealt with the question of expense. Mr. J. Louis Foucar, B.Sc., had carefully worked out an estimate after consulting with manufacturing experts, and came to the conclusion that an 11 ft. 6 in. barrel sewer could have the air purified and changed five times a day by means of proper machines for producing ozone and working fans, on a capital outlay of £150 per mile and an annual cost of £35 per mile. If experiments were to be made, it was submitted that the London County Council were the proper body to make them.

The motion was seconded by Dr. Annis (medical officer of Greenwich), and carried unanimously.

The Conference then nominated five representatives as a deputation to lay the matter before the London County Council.

Appointments Vacant.—Resident electrical engineer for Monmouth; assistant for teaching dynamo design at Glasgow and West of Scotland Technical College (£100); switchboard attendant for Kirkcaldy (25s.); drawing office and lecture assistant in mechanical engineering department, two demonstrators for the electrical engineering laboratories, and other appointments, for the Northampton Institute; additional assistant wanted for the City and Guilds Electrical Engineering Department, Exhibition Road (£150).

The Colliery Exhibition.—This Exhibition was opened at the Agricultural Hall, Islington, on Tuesday. It remains open until 20th inst. We hope to give particulars of the electrical features in a later issue.

Greenwich Power Station and the Observatory.—At the meeting of the Council of the Royal Astronomical Society, held on Friday, 8th inst., the following resolution was unanimously agreed to:—"That the Council learn with deep concern of the danger threatened to the Royal Observatory, Greenwich, from the erection of a large electric generating station near the Observatory, and desire to represent to the Admiralty at the earliest opportunity their conviction of the paramount importance of maintaining the integrity and efficiency of Greenwich Observatory, which has been adopted as the reference point for the whole world." It was further resolved that a copy of this resolution be forwarded to the First Lord of the Admiralty.

Liquid Fuel versus Coal.—An echo of the labour troubles and extensive fires which took place last August at the petroleum fields of Baku, is contained in the report for 1905 of the St. Petersburg Electric Lighting (1886) Co., which carries on business both in the Russian capital and at Moscow. During the internal disturbances both works were repeatedly compelled to shut down or limit their output, although the losses caused by damages to transformers and street lamps were comparatively small. The price of naphtha residuals, which were used for fuel at the Moscow works, if not also at St. Petersburg, increased by 33 per cent. owing to the Baku disasters, and the company was compelled to turn its attention to the use of coal, the four largest boilers at Moscow being converted from oil to coal firing. It is stated that, notwithstanding the high rates of freight, the most economical fuel for the Moscow works has proved to be pit coal briquettes obtained from Westphalia, in the west of Germany.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station Engineers.—Mr. A. N. DIXEY has obtained an appointment with the Great Indian Peninsular Railway Co., and has resigned his position as engineer-in-charge at the St. Pancras Borough Council's Regent's Park station. He leaves for Bombay next month.

Mr. T. KNATCHBULL HUGESSEN has resigned his position of mains superintendent to the Electric Lighting Committee of the Derby Corporation, and Mr. E. G. BOISSIER has been promoted to the post, with Mr. G. DEARLE as assistant superintendent. The cause of Mr. Hugessen's retirement is ill-health.

Mr. H. W. EVERITT was appointed, on June 6th, by the Clacton-on-Sea T.C. as chief engineer at the electricity works.

The Hull T.C. on June 7th decided to increase the salary of Mr. BELL, electrical engineer, by £100 a year, with two further annual increments of £50, and that of the assistant electrical engineer by £50 per annum, with two further yearly increments of £25.

Mr. J. W. HAME, assistant electrical engineer, has been appointed city electrical engineer at York at a salary of £300 per annum, rising by £25 a year to a maximum of £400.

Mr. A. W. BLAKE has resigned the position of borough electrical engineer under the Monmouth Corporation to join the firm of Mills, English & Co., Swansea, to which address all communications should be sent after August 1st. The Monmouth Corporation is retaining Mr. Blake's services as consulting engineer, and will appoint a resident engineer.

Tramway Officials.—Mr. A. C. GLINISTER, clerk to Mr. C. Barber, engineer and traffic manager of the Bournemouth Corporation Tramways, has been appointed personal clerk to Mr. T. B. Goodyer, general manager of the Croydon Corporation Tramways. On Friday, the 8th inst., Mr. Glinister was presented by the Bournemouth staff with a gold albert.

General.—Mr. W. R. COOPER, M.A., B.Sc., M.I.E.E., A.M.Inst. C.E., has been offered, and has accepted, the position of editor of the *Electrician*, in the place of Mr. F. C. Raphael, A.M.I.E.E., who retires on June 30th.

Mr. P. BARRETT COULSTON, a member of the staff of the Brush Electrical Engineering Co., Ltd., was married at Burnley on June 5th to Miss Ethel A. Mackenzie, of Burnley. Amongst the presents was a brass and bronze standard lamp and shade from the staff of the Manchester office of the Brush Co.

Mr. RICHARD L. GODFREY notifies that he has left Messrs. Henry F. Joel & Co., to take up a position with the Bowen & Odery Manufacturing Co., of 127, Pomeroy Street, New Cross, S.E.

At Umtali, Rhodesia, on June 2nd, Mr. HAROLD WRAGG was married to Bertha Frances, second daughter of Stephen Walker, Hunter House, Sheffield. Mr. Wragg was formerly on the staff of the Sheffield Corporation Electricity Department, and is now chief engineer to the Panhalonga Proprietory Mines and Rezende Mine, Mashonaland, S. Rhodesia.

CITY NOTES.

Kalgoorlie Electric Power and Lighting Corporation.

THE seventh ordinary general meeting of the shareholders of this company was held on Wednesday at Winchester House, Old Broad Street, Mr. Roger W. Wallace, K.C., presiding.

The CHAIRMAN, in proposing the adoption of the report, said the shareholders would remember that shortly before the last meeting the Kalgoorlie Tramway Co. decided not to take their electricity from them, but to lay down their own plant. He (the chairman) thought that would be very disadvantageous for both companies; and so, just before the meeting, he made one final effort with the Tramway Co. to see if they could not come to an arrangement by which they would lease the tramways, and so take an interest in the profits they made. He naturally felt that it was an anxious time for him to take that step, but he thought it the best thing to do, as it was not desirable to in any way widen the breach between them, especially as up to that time they had done everything possible to make a favourable arrangement between the two companies. In taking over a lease of the Tramway Co. he thought it was desirable that they should see what the conditions in Kalgoorlie actually were before they entered into the contract. He accordingly went out to Australia, and he found that there were many things in the contract which would operate disadvantageously to both companies, and which would cause a great deal of friction, and he came to the conclusion that it would not be advantageous to either company to go on with the contract that had been arranged. Eventually he succeeded in coming to an arrangement by which the contract for the leasing of the tramways should be postponed for five years, and that in the meantime the tramway company should pay them a fixed rate for the current which they took. The price arranged was 2½d. per unit. That seemed a high price to those who were purchasing electricity for power purposes in this country, but the conditions in Australia were entirely different. In reality it was only a fair price, and one that was advantageous to both companies. He was thoroughly satisfied with the contract that had been made, and the tramway company were also satisfied. By that means a great deal of friction that had existed between the companies had been got rid of. He thought the company was to be congratulated on the successful termination of negotiations which had been going on for two years, and which had been a very great strain on the board and the officials. His visit to Australia had also been of great advantage to the company in other respects. The mine-owners had considerable advantages over them, as they had no establishment charges to pay, and they did not put down anything for rent, and they made it appear that they could produce electricity really cheaper than they could. He thought it was a great advantage to the company that he was able to make the acquaintance of the mine managers, and to show to them what a great advantage their company was to the mines in order that even when they had their own supply they should take a great proportion of it from them. They had since then given them very large orders, and other mines which were about to install their own plant, had decided not to do so, but to take their electricity from them. That involved on their part doing a larger business at a cheaper rate. Of course, a large business at a cheaper rate was better than a small business which at any time they might be liable to lose. The result of that determination was that they had to increase their plant, and so they decided to put down a fresh unit of plant, and the whole of their supply was now contracted for, and they were producing their electricity at a very much cheaper rate than before, because of the new arrangements they had made. He thought that was a very satisfactory issue for the company, as it put their business on a stronger and surer foundation than it was in the past. As to the permanency of the goldfields in Kalgoorlie, he had gone over every mine in Kalgoorlie, and although the lodes were not so rich as they were, there was a vast amount of low grade ore to be treated, and the plant of the various mines were so well conducted that they were able to make profits out of ore which before could not be treated in a payable manner. There was no doubt, therefore, that they had got a business of a steady and solid character. There were other possibilities for Kalgoorlie, and he should think that at no very distant date there would be a railway from there to the other towns in Australia, and Kalgoorlie would be one of the commercial centres, so that should the mines fail them they ought to be able to get a full load for very many years. There had been a very unpleasant patent suit going on in Australia in connection with the type of condenser that they sent out. The action ought never to have been brought against them at all, but they could not prevent people bringing the action. He had seen the lawyers about it, and he thought they would hear but very little about it in the future. Their plant was now in thorough good working order, and the whole works were carried on very efficiently. Their present manager, Mr. Crocker, was a most excellent man, and was a very good friend with all the mine managers, and he held a position of great importance in the town. Regarding the balance-sheet, it would be noticed that the £33,000 first mortgage 6 per cent. debentures became redeemable in February next. They had made provision out of the profits for the premium needed to pay off those debentures at 102. He thought it would be to the advantage of the shareholders if in dealing with the redemption of those debentures, they could at the same time deal with the question of the past dividends, and the board hoped to produce a scheme to carry that into effect. As to the future of the company, he thought it was very satisfactory in every way.

Mr. EDWARD POPE seconded the motion.

Mr. LEE, Mr. FORD and other shareholders complained of the expenses of the company, and expressed a hope that everything that was possible would be done to economise.

The CHAIRMAN, in reply, said that it was a most difficult thing to conduct a company so many miles away, but they had every confidence in their manager and staff. As to the directors' fees, he or his colleagues could not take less than they did.

The report was then adopted.

Anglo-Portuguese Telephone Co.

THIS company's annual meeting was held on Friday last at the new offices, 31, Budge Row, E.C., Mr. Herbert Allen presiding.

The CHAIRMAN, in moving the adoption of the report, reviewed the operations of the year and said a few words about the future. Their last year's anticipations that they would have all-round improvement to record this year had been in no way falsified. In 1905 there was no interruption to the steady improvement which had marked the company's progress for some years past. He directed attention to the balance-sheet in proof of the soundness of their financial position. Notwithstanding the recent additions to capital, the total amount of £150,000 gave an average per subscriber well below that of the majority of similar undertakings, a fact which perhaps explained sufficiently why they could simultaneously give their shareholders good dividends and the Portuguese public a cheap service. The following table illustrates the company's progress, from a revenue and profit standpoint, in recent years:—

Year.	Gross revenue.	Gross Profits.	Net Profits.
1900	£19,223	£4,967	£3,519
1901	20,802	6,827	5,379
1902	22,728	8,926	7,124
1903	24,232	10,459	7,075
1904	25,962	10,796	8,360
1905	29,808	12,284	9,702

This showed that the gross revenue in the last six years had increased from £19,223 to £29,808, whilst the net profits in the same period had grown from £3,519 to £9,702. The latter figure would have been £11,709 but for an altered and more accurate method of dealing with subscriptions paid in advance. There was no reason why their progress should be less marked in the future than in the past. Having got their finances on a thoroughly sound footing, they could now devote undivided attention to the development of the business, for which there was still very wide scope. They were now establishing exchanges on the south side of the River Tagus, and from this hitherto untouched portion of their territory they ought to derive remunerative business. They were adopting a very conservative policy in the matter of dividend. Although the interim dividend paid in November last was equal to 33⅓ per cent. on the then issued capital, it represented a sum of only £25,000, which was less than half the amount of the reserve fund that had been built up out of profits in the previous 17 years.

Lest there should be any misapprehension in Portugal as to the precise significance of this distribution, or lest it might be thought they had been making excessive profits, he explained that even with this extra distribution of 33⅓ per cent., the dividends for the whole 17 years of the company's existence were only brought up to an average of 5 per cent., for they had up to that time only averaged about 3 per cent., taking the entire period. The board of a telephone company had two conflicting interests to reconcile, the shareholder and the user, and in the endeavour to hold the scales as evenly as possible between the two, they ran the risk of not wholly pleasing either. Mere surplus of income over current expenses was not net profit; the property all the while was depreciating and, in the case of a company working under a limited concession, provision had to be made against its expiration in case of non-renewal. The net profits for the year, after providing for debenture interest and so forth, were £9,702, and bringing in certain balances, there was an available total of £14,958. They were distributing amongst the shareholders only £4,500 (equal to 6 per cent. on an issued capital of £75,000), whilst carrying £5,000 to reserve and £5,458 to the credit of the current year's accounts. They could not be accused of dividing "up to the hilt." The policy of conserving their resources, instead of striving for mere immediate "effects," was the right one. The real benefit arising from the recent reconstruction of the Lisbon system should be yet more marked in the next year or so, as the present offices and plant were sufficient, with relatively little addition to working expenses, to serve a greatly increased number of subscribers. They might therefore anticipate that for some time to come the revenue would be largely augmented without a proportionate increase in the cost of working. However, shareholders should not overlook the fact that as from the beginning of the present year the entire share capital of £100,000 ranked for dividend, and with the beginning of next year the debenture sinking fund would come into operation, and the debenture service would then require an annual sum of £3,600. But even then they had not much cause for despondency, for assuming that the Portuguese exchange on London remained as at present, they anticipated a net revenue of £10,000 or £11,000 for the current year, after providing for debenture interest and sinking fund. This should enable them to improve upon the present rate of dividend and at the same time to place a further satisfactory sum to reserve. The number of telephone subscribers in Lisbon and Oporto was still far less than it ought to be, having regard to the population of those two cities. The indifferent service given to the public until a few years ago was doubtless responsible for that. Now, however, in the capital city they had a thoroughly up-to-date system. The number of subscribers was now increasing, as it should continue to do for many years to come. With this expansion of business, they would of course, from time to time need a little more capital, but, fortunately, they were possessed of ample resources for any outlay of the kind they could foresee for many years ahead. The capital account of a telephone company could scarcely ever be regarded as closed. In normal years their capital expenditure should not exceed £2,000 or £3,000, though in the current year that figure had been exceeded, owing to the cost of the new cable under the Tagus. But even this they had been able to meet out of surplus revenues, and that was how they would always endeavour to meet a great part of their capital expenditure. The laying of a cable under the River Tagus was completed in September last, thus connecting the central office with several new exchanges. In regard to the important question of depreciation, there was no class of commercial undertaking in which the precise measure of depreciation was more difficult to gauge than in that of a telephone company. He had heard it argued that, in the case of such undertakings generally, maintained in an efficient state out of revenue, there was no call for any specific provision for depreciation, but that was not the view of this board. At all events, the argument did not apply to this company, having regard to the fact that the present concession expires in 1937, the possibility of their not getting a renewal, and the doubt as to the precise amount of compensation which they might receive if the system were taken over by the Portuguese Government. It was therefore in contemplation by the board to take out a redemption policy of sufficient amount to relieve the shareholders of any anxiety they might otherwise feel on this score, and to defray the cost of this policy out of such sums as they might from time to time appropriate from revenue to reserve. This was the most effectual provision that could possibly be made against any risk of depreciation or loss of capital, and the simplest solution of the whole question. A suggestion had been made for a dividend distribution twice a year. The suggestion was not unreasonable, and would have due consideration.

Mr. F. W. Kerr seconded the motion.

The dividend resolution was passed on the motion of Messrs. C. Woolley and J. E. Kingsbury.

Mr. J. E. Kingsbury was re-elected a director on the London board, and the Marquez de Gouveia and Senhor Barbosa Colen were re-elected to seats on the Lisbon board.

The re-election of the auditors closed the meeting.

Lisbon Electric Tramways Co.

The eighth ordinary general meeting of this company was held at the London Wall Buildings on Wednesday, Col. Sir Charles Euan Smith presiding.

The Chairman, in proposing the adoption of the report, said that he was sure that they were all satisfied with the chairman's prediction at the last meeting as to the prospects of the company, and with what they had done since then. He thought that the expectations then held out by the chairman had been more than fulfilled. The extensions made during the year covered an area of 5½ miles, and they had before them more schemes for extension, some of which had been, or were about to be, made. In the opinion of the board more capital was required to meet the outlay already undertaken and about to be undertaken, and they proposed to issue further shares to the extent of 250,000. They had placed to the depreciation account £35,000 which, in the opinion of the board, was a reasonable appropriation, beyond this the profits of the company showed that they were entitled to propose the payment of a dividend of 5½ per cent. on the ordinary shares, and to carry forward £17,356. Since the close of the present account, the current four months to April 30th showed a gross increase of £7,000, and the cable receipts a gross profit of about £26,500, the largest since the incorporation of the company. They could congratulate themselves that they had every reason to expect a bright prospect for the current year. He thought they could say with pride that the people of Lisbon ought to feel proud that they had one of the finest tramway systems in Europe. As regarded the dividend, they thought that they ought to strengthen the financial position and amply provide for any contingencies that might arise before declaring a higher dividend. Besides adding to the depreciation account, they had increased the exchange reserve account by £5,000. The Portuguese exchange rate was the highest since the formation of the company, and he thought they should safeguard themselves while they were in a position to do so. With regard to the issue of capital that was necessary not only to provide for new extensions, but also to create some form of reserve which could readily be turned into cash. In conclusion, he referred to the able manner in which their local committee at Lisbon did their work for the protection of their interests, and to their untiring manager, Mr. W. Clarke, and all those who worked under him.

Mr. Ludwig Breitmeyer seconded the proposition, and the report was adopted.

Topsham Electric Light Co.—The first annual meeting was held on Saturday. The directors, in presenting their first annual report, were able to show satisfactory progress. The company commenced operations with five consumers, and the total on December 31st was 41. The total capital expenditure was £1,330. A few shares still remained not fully paid up. The income for 1905 amounted to £114. A net balance of £20 remained in hand after expenses were paid, and the directors recommended that this be used to commence a reserve fund to allow for depreciation, &c. The chairman said that at the end of next year a good sum would be available for disbursement to the shareholders. The directors were asking for more capital in order to add to the capacity of the plant. The report was adopted and officers elected, Mr. H. C. Gould being again appointed secretary and manager.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to—

Delhi Electric Tramways and Lighting Co.—100,000 6 per cent. preferred and participating shares of £1 each.

Kepitigalla Rubber Estates.—200,000 shares of £1 each, fully paid.

To appoint a special settling day in—

Johnson & Phillips.—168,365 vendors' ordinary shares of £1 each, fully paid, Nos. 6,636 to 175,000; and £58,333 vendors' 5 per cent. first mortgage debenture stock.

And to allow the following securities to be quoted in the Official List:—

British Aluminium Co.—£300,000 5½ per cent. Loch Leven debentures of £100 each, Nos. 1 to 3,000 (registered). (Renewed application.)

Stone (J.) & Co.—Further issue of 10,000 vendors' 5 per cent. cumulative preference shares of £10 each, fully-paid, Nos. 20,001 to 30,000.

The Committee has appointed a special settling day as under:—

Wednesday, June 27th.—National Electric Construction Co.—18,851 vendors' shares of £1 each, fully paid, Nos. 100,001 to 118,851.

And ordered the undermentioned to be quoted in the Official List:—

British Aluminium Co.—£300,000 5½ per cent. Loch Leven debentures of £100 each, Nos. 1 to 3,000 (registered).

Canadian General Electric Co.—The directors have declared a quarterly dividend of 2½ per cent.

National Telephone Co.—The transfer books of the 3½ per cent. and 4 per cent. debenture stocks will be closed from June 18th to June 30th inclusive, for the preparation of the warrants for the interest due July 1st.

South Staffordshire Tramways (Lessee) Co.—The report for 1905 states that the total revenue for the year amounts to £40,513, and the expenditure to £41,433, leaving a net loss of £920. The strictest economy has been practised in all departments, and the directors anticipate that by reason of the satisfactory results of the electrification of the Wednesbury-Darlaston line, and of the new agreements with the local authorities, the present year will show a marked improvement in both gross receipts and net result. A scheme for the mutual insurance of the third party risk has been entered into by the company jointly with other associated companies of the B.E.T. Co. Through the facilities afforded by the combined management of the lines by the Birmingham and Midland Tramways Joint Committee, a parcels and goods carrying business has been developed. Operations were commenced on November 1st last.

MARKET QUOTATIONS.

Wednesday, June 13th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Benzole (90 %)	per gal.	10½d.	..
a ,, (50 %)	per gal.	10d.	..
a Copper Sulphate	per ton	£26	..
a Lead, Nitrate	per ton	£28	..
a ,, White Sugar..	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	3d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	200/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	2¾d.	..
a ,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£160	..
b ,, Wire, in ton lots ..	per ton	£191	..
b ,, Sheet, in ton lots ..	per ton	£177	..
b Babbitt's metal ingots	per ton	£43 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	9⅛d.	⅛d. dec.
c ,, Tube (brazed)	per lb.	10⅛d.	⅛d. dec.
c ,, ,, (solid drawn).. ..	per lb.	10d.	⅛d. dec.
c ,, Wire, basis	per lb.	9¼d.	..
c Copper Tubes (brazed)	per lb.	1/-	⅛d. inc.
c ,, ,, (solid drawn) ..	per lb.	1/0¼	⅛d. inc.
g Copper Bars (best selected) ..	per ton	£100	..
g Copper Sheet	per ton	£100	..
g ,, Rod	per ton	£100	..
e ,, (Electrolytic) Bars ..	per ton	£92	..
e ,, ,, Sheets ..	per ton	£104	..
e ,, ,, Rod ..	per ton	£95	..
e ,, ,, H.C. Wire ..	per lb.	11d.	..
f Ebonite Rod	per lb.	8/8	..
,, Sheet	per lb.	9/-	..
n German Silver Wire	per lb.	1/7	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/2 to 5/2½	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	50/8	8d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£17 2 6 to £17 5	2/6 inc.
g ,, ,, Sheet	per ton	£19 to £19 2 6	2/6 inc.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot	£7 5	..
d Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p ,, rolled bars & rods	per lb.	1/1½ to 1/3	..
p ,, ,, strip & sheet	per lb.	1/4	..
o Platinum	per oz.	91/6	..
e Silicium Bronze Wire	per lb.	1/- to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
,, ,, in bars		£15 to £40	..
g Tin, Block (English)	per ton	£177 to £178	£8 dec.
n ,, Wire, Nos. 1 to 16	per lb.	2/3	1d. inc
p White Anti-friction Metals—			
"White Ant" brand	per ton	£46 to £70	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5⅝d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4⅛d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4⅛d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£32	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
j Walter H. Hindley & Co., Ltd.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Electricity v. Gas.—After reading the enthusiastic and lengthy comments of the daily Press in regard to the Brighton Co.'s retrograde movement in adopting gas for illuminating the new Victoria Station premises, *on the score of cheapness*, it is a consolation to read a *Times* paragraph of a dozen words or so, stating that "Euston Station was for the first time lit up entirely by electricity last evening."

STOCKS AND SHARES.

Wednesday Afternoon,

Trade throughout the country is too prosperous for the Stock Exchange to be busy. That is the last conclusion reached by a good many authorities, and if it be the case, stockbrokers have now magnificent scope for the cultivation of altruism. May be electrical trades might challenge the accuracy of the proposition enunciated in the first sentence, but the Board of Trade returns show satisfactory expansion in the general business of the country, and increase of general prosperity cannot fail to bring grist ultimately to the City mills, in addition to those of Yorkshire and Lancashire.

Our tale this week is not of the kind calculated to arouse enthusiasm. It is unpleasant to have to record movements mostly downward: unpleasanter to relate, for instance, that British Westinghouse Preference have reached a point at which they are practically unsaleable. And this, in spite of the fact that the price has fallen to 25s. middle. Manufacturing shares, as a whole, are dull. General Electric Preference at 9½, show a 5s. fall; Electric Constructions are ⅛ lower at 10s., and Callender's have lost their advance of last week. Cromptons are down ⅛ at 2, and so are Bruce Peebles Preference at 4⅞.

Railway stocks present no indication of rousing from their accustomed condition of dulness. Metropolitans are lower at 67 and Districts at 25½. Central London Ordinary is down to 87, City and South London to 41. It is considered an open question whether the Metropolitan will be able to squeeze out 2 per cent. on its Ordinary stock for the first half of the current year, although last July the distribution was at the rate of 2½ per cent. Discussion is now arising as to the wisdom of the policy of cheap fares inaugurated by the Central London, but the public have become too accustomed to this cheap travelling for an alteration to be made with safety.

Curious contradictions are heard in the City regarding the experience of the motor-omnibus companies with reference to the vital point of depreciation. We heard on the same day recently two men, who have gone very carefully into the finance of the undertakings, express diametrically opposite statements, one affirming that the various London concerns are above suspicion in the amounts they are allowing for depreciation, the other declaring that the greatest uncertainty still exists in the minds of experts as to whether the allowances are nearly liberal enough.

Electric traction issues are no less dull than the other sections of our markets. British Electric Traction Ordinary and Preference are both a little lower. Next Sunday, of course, is Hospital Sunday. The company's first debenture stock is up a point. Anglo-Argentine Trams of both kinds eased off, and Calcutta Trams lost 5s. at 9¼. For these movements there is no more reason than that of lack of confidence on the part of buyers. "Everyone is too sick of everything to buy anything," as a dealer in the market told us, with a gesture of fine disgust. The inquirer for causes of flatness in this or that, is countered with some such query as "Why are Consols dull?" Nor is the answer so irrelevant as it may appear at first sight.

Newcastle-upon-Tyne Electric Supply are nearly ½ better, but the Preference gave way a shade. Hove Ordinary lost 5s., and a similar decline put South London's down to 3. A would-be seller of Urban Ordinary found no buyer of his shares, and insisted upon having the price lowered 10s. to 3¾, while Edmundson's Preference have yielded another small fraction to 4⅞. A rise of 5s. in Westminsters is balanced by an equal fall in Metropolitans. Changes amongst the prior-charge stocks are limited to a fall of 1 per cent. in Central Electric Debenture, and a rise of the same sum in Chelsea Debenture.

Telephone stocks have relapsed into a state of immobility, and there is not much movement in Telegraph issues. Anglo-American Deferred, though still under the influence of profit-taking, are better at 26⅝, but Direct United States shares are ¼ lower at 15⅞ upon less rosy dividend estimates. At 14½ Western Telegraph shares are firmer, and a point rise is affixed to Pacific and European Debenture.

Langkon North Borneo Rubber Co.—At the statutory meeting held on Monday, Col. Sir A. FitzGeorge said they had put 20,000 rubber stumps into the ground, and 90 per cent. of them were sprouting. The working cost per acre, apart from London charges, was about £25. During the time they were getting no rubber from the trees, they were guaranteed by the North Borneo Co. to receive 4 per cent.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations June 6th.	Closing Quotations June 13th.	Business done week ended June 13th, 1906. Highest	Lowest.	Rise + or Fall —
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	83 — 88	83 — 88	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	22½%	31½%	67 — 69	67 — 69	67⅞	67	..
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½%	6 %	114 —115	114 —115	114½	114	..
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½%	26½ — 26⅝	26½ — 26⅝	26⅛	25⅞	+ ⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
1,932,856£	Commercial Cable Stng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	99	..	..
16,000	Cuba Telegraph	10	6½%	10 %	5 %	5 %	8½ — 9	8½ — 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½ — 9	8½ — 9	8⅝	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100—103⅝	100 —103	..	..	..
60,710£	Direct United States Cable	20	3½%	8 %	8½%	3½%	15½ — 16¼	15⅛ — 16	15½	15⅛	— ⅛
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,300,R.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	143 —146	143 —146	145½	144½	..
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	90 — 92	90 — 92	91	90½	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	108⅜	107⅛	..
300,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	7 %	14 — 14½	14 — 14½	14 1/16	14	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½—107½	105½—107½	107	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅝%	5½%	10⅞ — 11⅛ xd	10⅞ — 11⅛	11	..	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜ — 14⅝ xd	14⅜ — 14⅝	14 1/16	14⅜	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	39 — 41	39 — 41	40	39¾	..
42,800	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	57 — 59	57 — 59	58	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	..	1 1/16 — 1 1/16	1 1/16 — 1 1/16	20/3	19/6	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞ — 1	⅞ — 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	110 —112	110 —112	111½	110⅜	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	108 —110	108 —110	109½	108⅛	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14	12 — 14	13½	12⅞	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5½ — 5⅝	5½ — 5⅝	5½	..	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	98½	98⅛	..
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105	103 —105	104½	103⅜	..
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7½%	1⅜ — 1½	1⅜ — 1½	27/6	..	..
50,000	Do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1½ — 1⅝	1½ — 1⅝	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	99 —101	99 —101	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	100 —103	101 —104	..	..	+1
11,839£	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 7¾ xd	7½ — 7¾	7⅛	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	103 —106	103 —106	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7½	7 — 7½	7	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —112	110 —113	..	..	+ ⅛
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜ — 10⅛	9⅜ — 10⅛	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14 — 14⅛	14⅜ — 14⅝	14½	14 1/16	+ ⅛
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —106	103 —106	105½	104½	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	7/16 — 9/16	7/16 — 9/16	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	6⅞ — 7 xd	6⅞ — 7	6⅞	6¼	+ ⅛
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	5 — 6	4⅝ — 5¼	101/3	90/-	— ⅛
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..

* Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	7 — 7½	6⅞ — 7 1/16	7 3/16	6⅞	— 3/16
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅞ — 6⅛	5 15/16 — 6 1/16	6 1/16	5⅞	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	140 —143	140 —143	105	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	105	..	..
800,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	20 %	3⅝ — 4⅛	3⅝ — 4⅛	82/6	80/-	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	2⅛ — 2⅜	2⅛ — 2⅜	45/7½	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	5⅜ — 6⅛	5⅜ — 6⅛	6⅛	6 1/16	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	3⅝ — 4⅛	3⅝ — 4⅛	..	..	+ ⅛
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —104	100 —104	..	..	..
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	115 —118	115 —118	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	107 —110 xd	107 —110	108½	108⅜	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	102 —104	102 —104	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	6⅞ — 7⅛	6⅞ — 7⅛	7⅛	6 1/16	— ⅛
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	9¼ — 10⅛	9⅜ — 10⅛	10 1/16	10	— ⅛
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	114 —117	115 —118	117⅜	116	+1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	93 — 95	93 — 95	93	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6½ — 7	6¼ — 7	6⅞	6 1/16	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6¼	5⅞ — 6¼	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅝ — 2⅛	1 — 1½	37/6	30/-	—
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	80 — 85	79 — 84	80	..	—1
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	9/16 — 11/16	9/16 — 11/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	⅝ — ¾	⅝ — ¾	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1½ — 2	1½ — 2	..	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	84 — 86	84 — 86	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3⅜ — 3⅝	3⅜ — 3⅝	70/-	68/9	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅜ — 5⅝	5⅜ — 5⅝	5⅝	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5½	5 — 5½	5 1/16	5 1/16	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 —108	106 —108	106½	106⅛	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	103 —106	103 —106	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	9⅛ — 9⅜	8⅞ — 9⅛	9	..	—
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	8⅞ — 9	8⅞ — 8⅞	..	..	—
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	106 —108	106 —108	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	11 — 12	10¾ — 11¼	11	10⅞	—
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅝ — 6	5⅝ — 6	..	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108¼—110¾	108¼—110¾	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %	⅜ — ½	⅜ — ½	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 1/16 — 1 3/16 xd	1 1/16 — 1 1/16	21/9	21/6	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	99⅜	99⅛	..
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	87 — 89	86 — 88	87¼	86	—1
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	77 — 80	77 — 80	77¼	..	..
1,480,000	City and South London Railway	Stock	3½%	3⅜%	2½%	1¾%	41 — 43	40 — 42	42	41⅛	—1
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	..	2 — 2¼	1⅞ — 2⅛	..	..	—
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	98	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends. ‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations June 6th.	Closing Quotations June 13th.	Business done week ended June 13th, 1906. Highest	Lowest.	Rise + or Fall−
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	..	1⅞ — 1⅞	1⅞ — 1⅞	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1⅛ — 1⅛	1⅛ — 1⅛	23/9	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	104 —107	104 —107	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5¼%	6 %	6 %	13⅜ — 14⅜	13⅜ — 14⅜	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14⅜ — 15⅜	14⅜ — 15⅜	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99⅔ —100⅔	99⅔ —100⅔	..	..	..
800,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	3½%	95 —100	95 —100	..	..	..
800,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	3½%	95 —100	95 —100	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2⅜§	..	1⅜ — 1⅜	1¼ — 1⅜	..	..	..
17,189	Do. "A" shares, 01—017,189	5	Nil	Nil	2⅜§	..	2⅜ — 3	2⅜ — 3	54/4½	..	..
344,028‖	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000‖	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅜ — ⅜	⅜ — ⅜	10/-	..	— ⅛
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	2 — 2⅛	2 — 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9¼ — 10	9⅛ — 9⅜	..	..	— ⅛
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	93 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3⅞ — 4¼	3⅞ — 4¼	79/1½	77/6	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10¾ — 11¼	10¾ — 11¼	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	100 —101	100 —101	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12 — 13	12 — 13	12½	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5¼ — 5⅝	5¼ — 5⅝	..	..	..
41,978	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109 xd	107 —103 xd	108½	..	..
108,022	Do. do. Scrip. All paid	..	..	..	..	..	57½ — 59½	57½ — 59½	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10%	5 %	10%	17 — 18	17 — 18	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1⅝%	1⅝%	1½%	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	4 — 6	4 — 6	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	7 — 9	8 — 8½	..	..	+ ⅛
399,930	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	3 %	1 — 3	1 — 3	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8⅞ — 9¼	8⅞ — 9¼	9	..	+ ⅛
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	96 — 99	96 — 99	97⅛	97	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	⅛ — ¼	⅛ — ¼	2/9	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅛ — 1	⅛ — 1	19/-	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	102 —104	102 —104	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	4⅞ — 5¼	4⅞ — 5	..	..	— ⅛
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	7 — 8	7 — 8	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	8 — 9	7⅞ — 8⅞	..	..	— ⅛
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	100 —103	100 —103	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	32 — 34	32 — 34	..	..	..
150,000‖	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	94 — 96	94 — 96	94⅛	94½	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	100 —103	100 —103	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8½%	3 %	Nil	Nil	1½ — 1⅝	1½ — 1⅝	20/-	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2⅜ — 3⅛	2⅜ — 3⅛	61/3	60/-	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	78 — 83 xd	78 — 83	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5½%	4 ⅝§	5⅛ — 5⅝	5⅛ — 5⅝	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	102⅜	102	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8⅞ — 9¼	8⅞ — 9¼	8¾	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	8¾ — 9¼	8¾ — 9¼	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	101 —104	100 —103 xd	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4 — 5	4 — 5	..	..	..
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜ — 4⅞	4⅜ — 4⅞	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3¾ — 4¼	3¾ — 4¼	..	..	..
50,000	Do. do. 1903	5	..	4½%	4½%	4½%	3¾ — 4¼	3¾ — 4¼	82/6	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5¼ — 5⅝	5¼ — 5⅝	..	..	..
175,000‖	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107 —109	108 —110	..	..	+1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10½ — 11¼	10¾ — 11¼	10⅞	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12⅜ — 13⅜	12⅜ — 12⅝	12⅝	..	..
400,000‖	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2⅛ — 3⅛	2⅛ — 3⅛	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8 — 9	8 — 9	8½	..	..
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11¼ — 12½	11¼ — 12½	11⅝	..	..
400,000‖	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	109½	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
80,000	Edmundson's Electricity Corporation, Ord. Shares	5	7 %	7 %	7 %	5 ⅝§	3⅜ — 4¼	3⅜ — 4¼	..	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	4⅝ — 5⅛	4⅝ — 5	93/9	92/6	— ⅛
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
10,000	Folkestone, 1 to 10,000	5	..	5⅝%	5⅝%	5⅝%	5⅛ — 5⅝	5⅛ — 5⅝	5 7/8	5⅝	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	103¾	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	8¼ — 8⅝	8¼ — 8⅝	..	..	..
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12%	12 %	10 %	10 — 11	10 — 11	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	100	99½	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	2 — 2⅛	2 — 2⅛	41/10½	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	5⅛	5	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8⅜%	10 %	10 %	8¾ — 9¼	8 — 9	8⅜	8	— ⅛
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅜ — 5⅝	5⅜ — 5⅝	5 7/8	..	..
220,000‖	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000‖	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	96	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	101 —103	100 —103	..	..	— ⅛
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅞ — 7⅞	7⅞ — 8⅛	..	..	+ 1/16
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	6 — 6¼	5⅝ — 6¼	..	..	— 1/16
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13 — 14	13 — 14	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6¼ — 7	6½ — 7	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	10½ — 11¼	10½ — 11¼	..	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000‖	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2⅜ — 2⅞	2⅛ — 2⅞	..	..	..
50,000	Do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	3 %	4 %	4 %	3 — 3⅜	2⅞ — 3⅜	60/7½	..	— ⅛
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	⅜ — ⅜	⅜ — ⅜	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	4 — 4½	3⅞ — 4⅜	..	..	— ⅛
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	100 —102	100 —102	100½	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	10 — 11	10¼ — 11¼	..	..	+ ⅛
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	5	5 %	5 %	5 %	5 %	5 1/16 — 5 3/16	5 1/16 — 5 3/16	..	..	..

Shares not officially quoted :—Mackay Companies, ord., 77—79. Pref. 77—78.

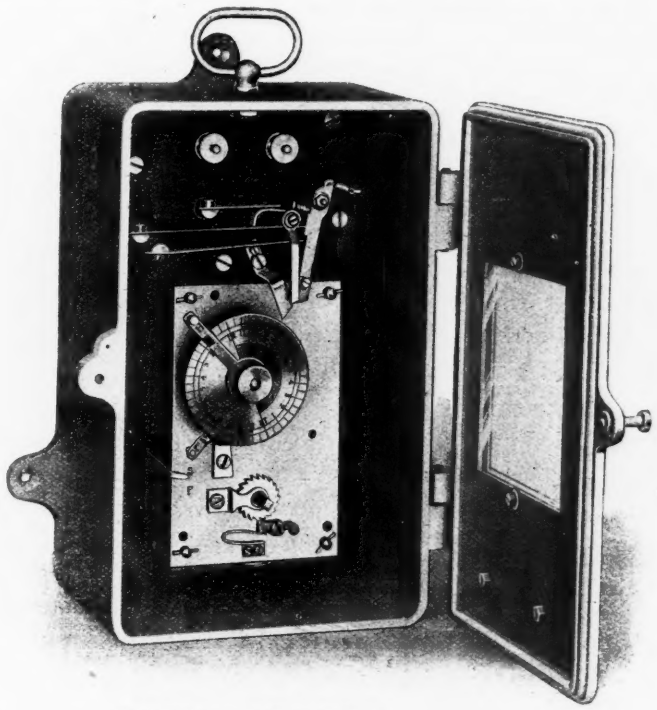
† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 4 per cent. (May 3rd, 1906).

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The "Venner" Time Switch.

We recently published an inquiry by "J. C. L. V." as to a reliable time switch, and forwarded to our correspondent several replies. The fact that two central station engineers strongly recommended a certain switch which they had recently tried with satisfactory results, led us to invite the makers to furnish us with particulars of the device, of which one form is illustrated herewith. The special features claimed for this switch are: Rapidity of make and break; wide range of setting (5 mins. to 23 hrs.);



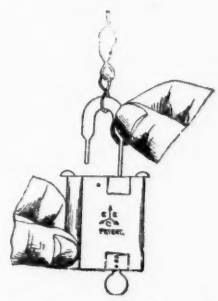
The "Venner" Time Switch.

and simplicity. The clock is hand-wound, and runs for over 35 days with one winding. The figure shows the switch mechanism above the clock, and the divided dial carrying the "on" and "off" hands, which are clamped securely by the nut seen on the front of the dial. The contact is quick at make as well as at break, and the mechanism appears unlikely to get out of order. The switch can be made selective, omitting any day, or days, in the week, and a variety of other types is made for different purposes.

One of our correspondents used this switch to control a three-phase network, star-connected, at 200 and 347 volts (with neutral lead), and says it is suitable for street lighting purposes on a three-wire network, controlling up to 50 amperes in each lead. Another used a number of the switches in connection with two-rate meters on motor circuits, public clock lighting, &c., and found them to answer well.

The "Shurlock" Lock Seal.

Messrs. Everett, Edgcumbe & Co., Ltd., of Collindale Works, Hendon, N.W., have recently put on the market an exceedingly

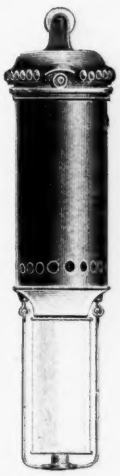


The "Shurlock" Lock Seal.

clever and effectual little device for sealing prepayment and other meters, also mail bags, &c. The locks are supplied with hasps suitable for any hole from 50 mils in diameter upwards; these hasps are supplied either flat or of round steel. The figure shows the lock ready to be secured to the article to be sealed; this is effected by simply pressing home the hasp into the sheath. It is impossible to tamper with the seal without the fact being very plainly apparent, and yet it can be easily broken without key in case of emergency. The seals are of thin copper, and are supplied in convenient form for the pocket, and are applied without any tool. In addition to every hundred seals bearing a different number for ready identification, they can also be indelibly signed by means of an ordinary lead pencil.

Photographic Arc Lamp.

The accompanying figure shows the Jandus photographic arc lamp of the enclosed type, concerning which Messrs. Drake and Gorham, Ltd, have just issued a new circular. The advantages of the lamp for portraiture, on account of its high actinic power, are

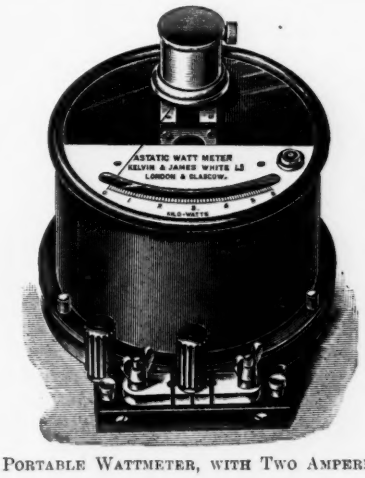


Photographic Arc Lamp.

pointed out. It is also recommended for very rapid printing; patent reflectors are fitted inside the globe, ensuring a good even light over the whole negative. Some figures as to cost and current consumption are stated, also results of exposure experiments; a list of prices of lamps for D.C. and A.C. is given.

Portable Wattmeter.

A neat portable wattmeter with horizontal scale for general testing has been brought out by Messrs. Kelvin & James White, Ltd.,



Kelvin Portable Wattmeter, with Two Ampere-ranges.

of Glasgow, and is illustrated herewith. The instrument is of the electro-dynamometer type, with coils arranged astatically, so as to be uninfluenced by external magnetic fields, including that of the earth; the case is made of non-conducting material, to prevent eddy-currents, and the scale is of the mirror type, free from parallax, and direct reading, with pointer on edge. The instrument is suitable for use on both A. and D.C., and is unaffected by

wave-form, while the accuracy is independent of the power factor within practical limits. By means of the plugs shown in the figure, two ampere-ranges are obtainable.

A pamphlet issued by the makers gives concise instructions, with diagrams, for measuring power on one, two and three-phase circuits, and with the aid of the curve which we reproduce herewith, using two wattmeters, the value of the power factor in an

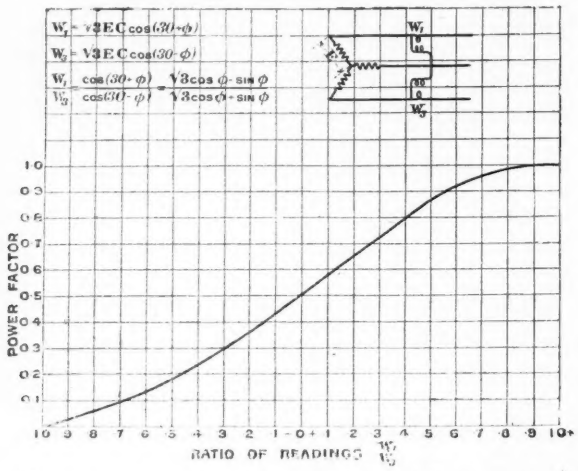
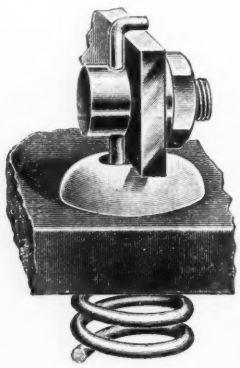

$W_1 = \sqrt{3}EC\cos(30-\phi)$
$W_2 = \sqrt{3}EC\cos(30+\phi)$
$\frac{W_1}{W_2} = \frac{\cos(30-\phi)}{\cos(30+\phi)} = \frac{\sqrt{3}\cos\phi + \sin\phi}{\sqrt{3}\cos\phi - \sin\phi}$
POWER FACTOR
1·0 0·3 0·6 0·7 0·6 0·5 0·4 0·3 0·2 0·1
10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10
RATIO OF READINGS $\frac{W_1}{W_2}$

Diagram showing Relation between Power-Factor and Ratio of Reading.

unbalanced three-phase circuit can be determined. Messrs. Kelvin and James White will forward a copy of this curve on a larger scale to any engineer who desires it.

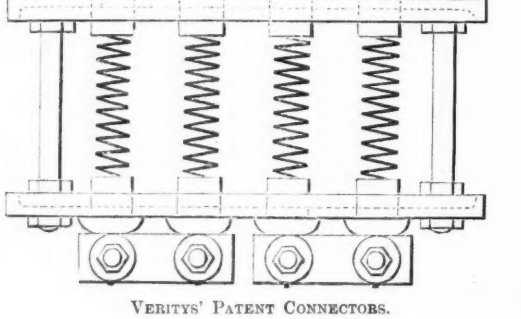
Connector for Motor Starters.

The question of proper connections for the ends of resistance coils, although apparently simple, is one which presents considerable difficulties. Ordinary terminals are of no use, as they work loose



Veritys' Patent Connector.

and are awkward to connect when a wire is stretched into the form of a helix. To twist the ends of the wires together is good as far as it goes, but it does not lend itself to facility in renewals.



Veritys' Patent Connectors.

Solder, of course, must be avoided. In Veritys' patent connector for motor starters, and motor and dynamo regulators which we illustrate, a pin of about $\frac{5}{16}$ in. diameter passes through a $\frac{1}{8}$ in. plate. The pin has a hole drilled through it axially on one side, and on the other side is screwed and fitted with a small nut and washer. The wire from the resistance coil comes through a small porcelain insulator, and is merely passed through a small hole in this pin, which is then screwed up tight. This forms a good connection for the coil, and the plates can be fitted with either two or more pins depending upon the number of connections to be made, and according to whether the coils are in series or parallel.

The ends of the wires are bent over the top of the plate which prevents the remotest chance of them getting free; but it is a very simple matter to renew any coil.

This device, which is protected by patent, is used on all Aston starters and regulators of 10 h.p. and over.

THE KING EDWARD VII. SANATORIUM.

This Institution, which is situated at Midhurst, Sussex, was opened by his Majesty the King on Wednesday.

Mr. E. R. Dolby, M.Inst.C.E., of Westminster, has acted as consulting engineer for the engineering works. These may be divided into the following parts:—Steam generating plant; electric lighting, telephones and bells; heating and hot water service; laundry; lift; kitchen; miscellaneous. Of these the electrical portion only are of interest to our readers.

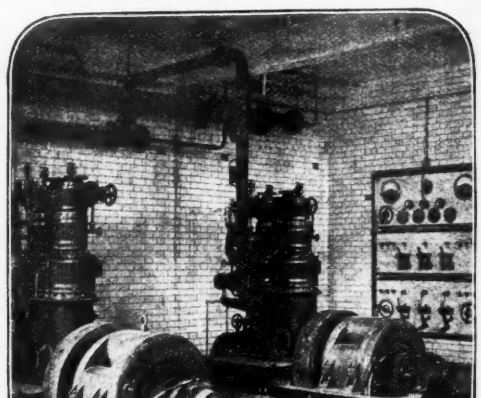
The steam generating plant consists of two Lancashire boilers, each 30 ft. long × 7 ft. 6 in. diameter, built by Messrs. Galloway Bros., Manchester, for a working pressure of 160 lb. per sq. in. A Green's economiser is fixed in the back flue, and the scrapers are actuated by a small steam engine. The stokehole is about 10 ft. below outside ground level, so that the coal can easily be delivered from carts.

The steam piping in the boiler house is of mild steel throughout, and in duplicate.

Adjoining the boiler house on one side is a workshop containing the usual machine tools, driven by an electric motor, and on the other side is the room occupied by the feed pumps, hotwell, &c.

The feed pumps are by Messrs. G. & J. Weir, Ltd., Glasgow, and are fixed close to the hotwell, which is a large closed cast-iron tank into which all the condensed water from the steam traps is carried, and also the cooling water which passes through the engines.

From this room access is obtained to the engine room; this is 53 ft. 6 in. long by 35 ft. wide and 11 ft. 6 in. high, and in it



Generating Plant at Midhurst Sanatorium.

are installed the electric lighting sets and the calorifiers, pumps, &c. The walls are of white glazed brick throughout, and the floor is paved with dark red tiles.

Messrs. Foote & Milne, Ltd., Westminster, were the contractors for the electric lighting, telephones, &c. The electric generating plant consists of three combined sets, each comprising one of Messrs. Willans & Robinson's compound high-speed engines, each capable of developing 48 b.h.p. at 150 lb. pressure and a speed of 470 r.p.m. Each engine is coupled to a compound-wound dynamo made by Messrs. Newtons, Ltd., Taunton, giving 250 volts and 100 amperes. Two of these sets are sufficient to supply the maximum demand for light and also the current for the various motors.

There is at present no secondary battery, as it was considered desirable to limit the initial cost of the plant, and moreover the heating plant is so designed as to use the exhaust steam, so that the running of one set on a comparatively light load at night is not so uneconomical as it might appear.

The electric cables from the three sets are carried to a white marble switchboard let in flush with the wall and surrounded by a

teak frame. Access is obtained from the pump room at the back. Upon the board are mounted Kelvin voltmeters, amperemeters and automatic cut-out switches.

From the board are carried two feeders which supply a ring main which passes round the subways below the main buildings, and the network is so arranged that in case of accident to one feeder the other would still be able to give a supply of current. From the ring main are taken branches to the various distribution boards.

The wiring is chiefly run in wood casing of segmental section on the face of the walls so as to afford easy access to the wires while providing no lodgment for dust. The principal rooms are, however, wired in steel tube sunk in the plaster or behind the tiles.

The fittings in the chapel, dining hall, &c., are of an ornamental character, but elsewhere they are of strong simple design.

There is a complete system of telephones with an exchange in the porter's lodge, and also a very complete system of electric bells, the bell pushes being so designed that a telephone can be hung upon each push to enable a sick patient to communicate directly with the nurse on duty in the service room.

The laundry contains the usual plant, but special reference should be made to an electric ironing machine. The iron is heated by the electric current instead of by gas. An electric motor is fixed on top of the airing room, and this drives the whole of the shafting and machinery.

An electric passenger lift of special design has been put down by Messrs. Waygood & Co., Ltd., of London. The motor and gearing are placed in the basement. The car is merely a platform with sides and back, but no roof, and it is suspended at the sides. The control is of the most recent press button design, so that no attendant is necessary, and the safety apparatus is of special design. The car is built to carry a load of 12 cwt. at a speed of 100 ft. per minute.

A vacuum cleaning apparatus is installed in the feed pump room near the boilers; this is driven by an electric motor, and will be used for cleaning the carpets and mats so as to avoid any chance of the dissemination of infected dust. The apparatus was presented to the sanatorium by the Vacuum Cleaner Co., of London.

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

The Effects of Higher Import Duties.

The proposals contained in the new tariff contemplated by Spain have provoked an outcry in different manufacturing trades in Germany, and particularly on the part of the electrical industry. The representatives in Spain of Teutonic electrical firms urged the latter to at once take action in official circles, while the association for the preservation of the economic interests of the German electrical engineering trades lost no time in addressing a petition to the Imperial Chancellor, pointing out that the Spanish tariff projected an increase in many cases of from six to seven times the amount of the existing duties, that objections had to be lodged by April 30th, and that the coming into operation of the tariff on July 1st next would exclude German manufactures from that country. It is mentioned that the value of German electrical exports to Spain amounted to £225,000 in 1905.

The surprise caused by the publication of the new Spanish tariff had been preceded by an interesting paragraph in the report for 1905 of the Dresdner Bank, which co-operated in the establishment of the North German Marine Cable Works Co., of Nordenham, and the East European Telegraph Co., which owns and works the Constanza-Constantinople cable. After stating that the inland and foreign enterprises of the electrical industry made good progress in 1905, the report remarked that it appeared as if the brisk employment of the works and factories would extend over the critical period incidental to the coming into operation of the increased import duties. At the same time the restrictive effects of the latter, it was submitted, might possibly make themselves felt sooner or later.

German Companies.

The Bergmann Electricity Works Co., of Berlin, in the course of the report for 1905, states that a further development in the business took place, the total turnover increasing from £535,000 in 1904 to £660,000 last year. The prices of manufacturers did not always follow the continual advance in the rates for raw materials, and it has only been possible to dispel the disproportion in recent months by the German works agreeing among themselves to increase quotations. A few items from the accounts are given below for the past two years:—

	1905.	1904.
Share capital	£500,000	£425,000
Net profits	105,380	97,640
Dividend, per cent.	18	18

The additional capital of £75,000 in 1905 participates in the dividend to the extent of one-half. It is pointed out in the directors' report that the company has taken up the construction of fresh manufactures, including electricity meters. The glow lamp factory yielded satisfactory results, and although the production could be considerably increased, the company preferred to arrange a price agreement with the glow lamp syndicate on the basis of a fixed output, in order to prevent underselling. A special share in the expansion of the undertaking was taken by the machine department. As a result of the increased call for lifting appliances and for mining plant, it is proposed to largely extend this department as the brisk demand for these special classes leads to the assurance that their production in bulk will be remunerative. The new shop for the construction of turbines on the Rateau system will be ready in May, and the work will then be undertaken to the full extent contemplated. The prospects for the current year having regard to the sales in the first quarter are stated by the directors to be entirely favourable.

The directors of the Hartmann & Braun Co., of Frankfort-on-Main, in reviewing the satisfactory progress of the undertaking in the past five years, state that the year 1905 was a period of extraordinary development. The curves relating to quantity and value of the production continue to recede from each other. The former, for instance, increased by 50 per cent. in the five years, but the value of the output only rose by 28 per cent. in the same period. After providing for working expenses and writing off £8,371 for depreciation, as contrasted with £6,800 in 1904, the accounts indicate net profits of £20,493, as against £19,157 in the preceding year. A dividend is to be paid at the rate of 10 per cent on a share capital of £85,000, as compared with 9 per cent. in 1904. The instructional workshop for intending makers of instruments of precision seems to answer its purpose, although the directors again state that difficulty is experienced in obtaining well-trained workers for delicate mechanism, a difficulty which the workshop in question seeks to overcome. As to the future prospects, the report states that a gratifying increase in the value of the orders has taken place in the first quarter of the present year, but it cannot yet be said what effects the new treaties of commerce will have upon the electrical industry. The French Government have raised the duty on the products made by the company by 25 per cent., and if the further advance demanded by the Chambre Syndicale de l'Industrie Electrique were agreed to, the tariff would become entirely prohibitive.

The past year, according to the report of the Land und Seekabel Werke (Land and Marine Cable Works), of Cologne-Nippes, afforded the company uniform and good employment throughout the 12 months, and the turnover materially increased as compared with 1904. Large orders were received, among others, from countries which, under the new treaties of commerce, raised their import duties on cables. The higher prices of raw materials did not always render it possible to advance the quotations for manufactures to a corresponding extent, this being specially the case in regard to insulated conductors. An improvement in the latter respect is so far to be noted that better qualities, although slowly, are making progress both in the inland and the export market. The two years' financial results are as follows:—

	1905.	1904.
Share capital (paid up)	£262,500	£262,500
Net profits	28,308	21,844
Dividend, per cent.	8	6

The directors state that the financial participation in the Russian cable factory has been terminated and extinguished from the investment account, but the latter now contains preference shares of the North German Marine Cable Works, of Nordenham. An extension was made in the apparatus branch, which until then was mainly concerned with the production of protective and safety appliances for installations, by the acquisition of a business at Hanover for the manufacture of measuring instruments of precision. The present year is expected also to yield satisfactory results consequent upon the orders on hand and the favourable course of the electrical trades.

The Gesellschaft fur Elektrische Unternehmungen (Company for Electrical Enterprises), of Berlin, is an investment company of considerable proportions. In the report of the directors reference is first made to the decision of the extraordinary meeting last November to increase the share capital by £375,000 as from January 1st, 1906, for the purpose of exchanging the new shares for shares in the Neckar Works Co., of Eisslingen, and for shares in the Kieff Electricity Co., the latter of which are now entirely in the hands of the Berlin Co. The company also participated to the extent of £250,000 in the Rhenish Electricity Works Co., of Essen, which is seeking to establish a large monopoly in regard to the supply of light and power in Rhenish Westphalia. Coming now to the accounts, the financial position is shown briefly as follows:—

	1905.	1904.
Share capital	£1,500,000	£1,500,000
Bonds	1,750,000	1,750,000
Net profits	140,245	113,404
Dividend, per cent.	7½	6

It will be understood that the fresh issue of ordinary shares amounting to £375,000, which will bring the total shares up to £1,875,000, does not come into consideration in the accounts for 1905. The accounts indicate that although the interest received from investments realised £90,000 more than in 1904, the profits from the sale of securities declined by £60,000 as compared with the preceding year. Among the company's investments, which are booked at the value of £3,554,500, may be mentioned shareholdings in Brown, Boveri & Co., the British Thomson-Houston Co., the German Transmarine Electricity Co., the Anglo-Argentine Tramways Co., and the Berliner Telephone Works Co.

The report of the Voigt & Haeffner Gesellschaft, of Frankfort-on-Main, states that the large appropriations which were made in 1903 and 1904 for improving the firm's manufactures, have answered their purpose and led to a considerable augmentation in the turnover. The inland business in 1905 increased somewhat greater than the growth in the export trade. Having regard to the

adoption, for improved methods of working, of machines and machine tools of the most modern type, and the consequential depreciation of the old plant, the directors have written down the value of the latter by an extra amount. As gross profits, the accounts show £43,244, as compared with £26,301 in 1904, and net profits of £14,263, as against £5,158. It is proposed to pay a dividend of 7 per cent., as contrasted with 4 per cent. in the preceding year. The directors state that the turnover in the first quarter of 1906 has been twice the amount of that in the corresponding period of last year, and that results at least as favourable as in 1905, may be expected for the current year.

The following is a list of the dividend announcements of other companies for the past two years.—

	1905.	1904.
Ludwig Loewe & Co.	12	10
Mix & Genest...	8	7½
Deutsche Kabelwerke	7	5
Gesellschaft fur Gas und Elektricität ...	6	5½
Dr. Paul Meyer Gesellschaft	6½	4
Voltohm, Seil und Kabelwerke	3	nil
Vereinigte Isolatoren Werke (first year) ...	12	—

SWISS COMPANIES.

The shareholders in the Aluminium Industry Co., of Neuhausen, were informed by the chairman at the recent general meeting that the convention of aluminium producers, which had been in operation for five years, would expire at the end of 1906, and the renewal of the agreement was improbable. According to the report presented at the meeting, all the company's works were fully employed during 1905, and in order to keep pace with the increasing demand for the metal, the company acquired, on the basis of a concession for 99 years, water power rights on the Navizance and Rhone, near Siders, in the spring of last year. The new works were already in hand, and the first part of the plant would be in operation within a year, the necessary capital being provided by the issue of £400,000 in additional shares ranking for dividend as from January 1st, 1906. The report stated that the favourable results for the past year were again materially contributed to by the branches carried on in connection with the principal manufacturing department. The following figures are extracted from the report :—

	1905	1904
Share capital (paid up)	£520,000	£320,000
Obligations	229,200	232,000
Gross profits	189,967	129,940
Depreciation	84,000	49,430
Dividend, per cent.	22	18

The amount distributed as dividends in the past six years totals 96½ per cent., or an average of 16 per cent. for that period. All the works are fully occupied at the present time, so that the prospects for the current year are favourable. At the same time, as the chairman recently intimated to the shareholders, no guarantees exist that the company will continue to be free from competition in the future.

The report of the directors of the Alioth Electricity Co., of Basle, states that notwithstanding the general development in the electrical engineering industry during 1905, it was impossible to bring prices to a level which would yield equivalent results. During the year the company delivered 871 transformers of a total of 23,367 KW., and 3,019 dynamos and motors of 51,081 KW. The profits amounted to £23,224, as compared with £19,114 in 1904, and after providing for depreciation, the balance remaining allows of the payment of 5 per cent. on the priority shares, being at the same rate as in the preceding year. The holders of ordinary shares, however, do not receive any dividend, this having been the case also a year ago. The total share capital of the company is £240,000, apart from £120,000 issued in the form of bonds.

The Schweizerische Gesellschaft fur Elektrische Industrie (Swiss Electrical Industry Co.), of Basle, which is an investment company, belongs to the group associated with the Siemens & Halske Co. In addition to an obligation issue of £1,200,000, the company has a paid-up ordinary share capital of £400,000 out of a total nominal amount of £800,000. The accounts exhibit net profits of £28,707 for 1905, as compared with £27,660 in the preceding year. It is proposed to pay a dividend of 6 per cent., as contrasted with 5 per cent. paid in 1904. The company is interested, among others, in the Mexican Light and Power Co.

The Motor Gesellschaft fur Angewandte Elektrizitat (Motor Co. for Applied Electricity), of Baden, is closely associated with the firm of Brown, Boveri & Co., and its operations extend to the working of central stations and investments in electrical enterprises. At present the company has a paid-up capital of £452,000, and an obligation issue amounting to £320,000. The accounts for 1905 show net profits of £30,843, as compared with £24,690 in the preceding year, and a dividend of 6 per cent. has been declared on the paid up capital, this comparing with 5 per cent. paid in 1904. The remainder of the additional share capital, which was decided upon in June of last year, will be issued shortly, and will bring the total capital up to £600,000.

Stockport Lighting.—The T.C. has decided to extend an existing main to Davenham to afford this district a supply of electricity for lighting. A guaranteed rental at the outset of £30 per annum had been obtained.

THE EFFICIENCY OF CONDENSERS AND ITS EFFECT ON POWER STATION COSTS.

A commentary and corollary on Prof. Weighton's Paper.*

BY R. M. NEILSON.

THE exhaustive experiments which have been conducted during the last eighteen months by Prof. Weighton, at the Armstrong College, Newcastle-on-Tyne, have brought to light certain facts about condensers and certain laws relating to the condensation of steam which are of the utmost importance to those concerned in the manufacture and running of condensing plants.

We are, however, concerned in this article only with the bearing of the subject on electric power station costs. The efficiency of a steam-driven electric power station depends on many items. One of these items is the efficiency of the condensing plant, and in steam turbine stations this item is of very great importance. It is hardly necessary at this date to mention that at high vacua, such as are usually aimed at in the running of turbines, an increase of vacuum of 1 in. of mercury reduces the steam consumption of the turbine per KW.-hour from 4 to 7 per cent. This is excluding the steam or the mechanical or electrical energy taken to drive the pumps. It is obvious, therefore, that the efficiency of the condensing plant has a most important influence on the station coal bill. This is recognised at the present day by power station engineers, but the full effect which condensers exercise on power station economy has hardly been generally appreciated.

The total cost per unit generated is affected by the condensers in several ways, and it will be convenient to consider these one by one.

In the first place, the attainment of a high vacuum absolutely depends upon the design and proportions of the condensing plant. Unless a plant of suitable nature and capacity is employed, a high vacuum cannot be obtained. It should be noted—and it cannot be too strongly emphasised—that the capacity of a condenser is not simply a question of amount of cooling surface. It is much more a question of arrangement of cooling surface and of general design. One condenser may have an ultimate capacity many times greater than another, although the two have exactly the same cooling surface. For example, condensers of the ordinary marine type are capable of dealing with a maximum of about 10 to 12 lb. of steam per sq. ft. of cooling surface at a vacuum of, say, 27 in. A condenser of the "Contraflo" type tested by Prof. Weighton easily dealt with 35 lb. of steam per sq. ft. of cooling surface, even when the vacuum was as high as 28·57 in. (referred to a 30-in. barometer).

The first rule to be stated is, therefore, that to obtain a high vacuum a condenser of suitable design and proportions must be employed. The most suitable condenser is not necessarily the most expensive.

The second way in which the condensers affect the power station costs has reference to the amount of cooling water required to condense a given amount of steam. Confining ourselves to surface condensers, which are usually employed, and are generally to be recommended, these differ among themselves to a great extent. Prof. Weighton experimented with a surface condenser of a very usual type, in which the circulating water made two passes through the tubes. With this condenser, which for distinction may be termed the "old type," about 42 lb. of circulating water, entering the condenser at 50° F., were required per lb. of steam at a vacuum of 28 in. With a condenser of the "Contraflo" type he found that with the circulating water entering at the same temperature only 24 lb. were required per lb. of steam at the same vacuum. The "Contraflo" condenser, therefore, required only 57 per cent. of the water required by the "old type" condenser.

* Paper by Prof. R. L. Weighton, read before the Inst. of Naval Architects, April 5th, 1906, on "The Efficiency of Surface Condensers."

When the water is obtained for nothing, or for a fixed annual charge irrespective of the quantity used, the reduction in amount of water used only reduces the cost of the pump and the power absorbed by it. In many stations, however, water has to be paid for by meter at a high rate, and condensing can only be adopted by employing means such as a cooling tower for cooling the circulating water and using it over and over again, supplying a little fresh water to make up for leakage and evaporation. In such a case a reduction in the amount of circulating water to the smallest possible amount is of the utmost importance; and it may be quite possible by a good choice of a condenser to reduce the cost of the cooling tower by 30 to 40 per cent. There is also a saving to be effected in the cost of pumping the water up to the distributing troughs in the cooling tower. It is true that the smaller the quantity of circulating water used per lb. of steam, the higher is the temperature of the circulating water when leaving the condenser, and, therefore, the more heat per lb. has to be taken out of it in the cooling tower. It is, however, much easier to cool the small quantity of relatively hot water than the large quantity of cooler water.

The third way in which the condensers affect the power station costs has reference to the temperature of the water delivered to the hot well from the condenser. If the boiler feed is taken from the hot well, as is usually the case, the hot well temperature of course governs the amount of heat which has subsequently to be added to the water to bring it up to boiling point in the boiler, and therefore affects the coal consumption. Now the temperature of discharge of the condensed water from the condenser varies in practice to an extent quite sufficient to appreciably influence the coal bill. In Prof. Weighton's tests, the "old type" condenser at all vacua over 27 in. discharged the water of condensation at a temperature from 10° to 15° F. below that obtained in the case of the "Contraflo" condenser. Now an increase of 11° or 12° in the temperature of the hot well will allow of the boiler generating at least 1 per cent. more steam on the same coal consumption; or, with the same demand for steam, will reduce the coal bill at least 1 per cent. while slightly increasing the reserve boiler power.

The fourth way in which the condensers affect the power station costs has reference to the manner in which they adapt themselves to deal with varying amounts of steam. Few electric power stations are so fortunate as to have a high load factor; and the total exhaust steam to be condensed per hour varies greatly. When each engine has its own condenser, some of the condensers may be given a nearly constant supply of steam, but some at least will have to deal with a varying amount. It is, therefore, important that the condensers should be able to adapt themselves to deal effectively with any amount of steam which may be given them up to their utmost capacity. That is to say, it is desirable that the required vacuum should be obtainable with a low consumption of circulating water and a high hot well temperature, not only when the condenser is working at its rated capacity, but when it is dealing with any greater or less amount of steam within its working limits.

Prof. Weighton's tests on one of the "Contraflo" condensers illustrate well what is desirable in this connection. This condenser within the limits of the series of tests, *i.e.*, from 700 lb. of steam per hour to 2,000 lb. of steam per hour, used a practically constant amount of circulating water per lb. of steam for a given vacuum. This shows that in this condenser the increased coefficient of transmission of heat through the sides of the tubes due to the increased velocity of the circulating water when the condenser was condensing at a high rate, must have exactly compensated for the reduced time that the water was in contact with the tubes—a point of considerable interest. The hot well temperature was also practically constant for a given vacuum. The condenser was thus equally good when dealing with large and with small amounts of steam. It is unnecessary to emphasise the importance of this, which will be obvious to power station engineers.

Condensers constitute an important part of a power station equipment; they exercise a considerable influence on power station costs; and their selection calls for much care and good judgment.

STANDARDISATION OF RUBBER MIXTURES.

By DONALD S. MUNRO.

Buyers of electric cables have to take much on trust. They can measure the length, area and conductivity of copper. They may test the insulation resistance and electrostatic capacity per unit of length, under certain conditions. They may subject the dielectric of a given cable to pressures considerably more than the working pressure. They may cut off a portion and find the pressure at which it breaks down.

The thickness of insulating materials may be measured. The various insulating substances may be tried by sundry physical tests, or by the amount of ash left on burning. Finally, these substances may be chemically analysed.

In practice, however, chemical analysis and, indeed, many of the other tests, are neither convenient nor conclusive.

The buyer is told, and he soon learns by experience, that with very inferior material it is possible to make a cable which will comply with almost any specification, and pass nearly every test except the all-important one of time.

Not only by various makers but by each, cables are offered of widely varying price, yet to all appearances alike. No wonder the idea gets abroad that they are alike—except in price.

In this country we have had to fall back on the good old-fashioned business principle of putting entire trust in makers of good reputation.

In America and on the Continent of Europe, if we may judge by what is said, this method has not always proved satisfactory to buyers.

Mr. John Langan, in a paper presented to the American Institute of Electrical Engineers in April, laments the helplessness of the engineer in this question and discusses difficulties and remedies. He deals chiefly with rubber cables, which are so greatly used in the United States, especially for high voltages underground.

In his paper he criticises the rules of the National Code, and of the Board of Fire Underwriters. He points out the unreasonable figures embodied in these rules, and the disadvantages of subjecting a cable to a definite high voltage per unit of thickness of insulation; for the dielectric strength of an insulator is not always proportional to its thickness; it varies with care in manufacture. By such a test a cable may be strained and permanently injured, and it is not always possible to get the specified test pressure.

He refers in some detail to the well-known fact that most electrical tests are no guarantee of durability.

He does not, however, set little store by such tests, but he very properly attaches much importance to such physical tests as maximum elongation of rubber without fracture; a definite elongation and prompt and vigorous return to its approximate original length, and gives figures for these.

Mr. Langan asked a number of well-known makers to submit samples of a 20,000-volt cable; the insulation to contain not less than 30 per cent. of fine Para free from all shoddy, rubber substitutes and the like, and to comply with certain definite electrical and physical requirements.

Some did not meet the physical tests, and those which did were analysed. It was found that the trials were successfully undergone not only by compounds which contained 30 per cent. of pure Para, but also by mixtures composed of 15 per cent. of Para and 30 per cent. of cheaper grade.

Nothing is said as to the nature of the remainder of the composition, although, obviously, some kinds of "loading" would be more injurious than others.

It is pointed out that the admixture of cheaper rubbers is likely to lessen the life of cables, because they contain a larger amount of acetone solution or resinous matter subject to chemical change.

It is the low percentage of such resinous matter which distinguishes fine Para such as Bolivia, Maderia and Up-River from cheaper grades such as African, Madagascar and certain South American products. Mr. Langan concludes his paper by recommending the standardisation of rubber mixtures, and gives examples of specifications and tests

applicable to compounds containing not less than 30 per cent. and not more than 32 per cent. of fine Para rubber.

He gives rubber thicknesses, one-minute voltage tests, megohms per mile, and also elasticity and tensile strength limits. Reliance is chiefly placed, however, on chemical analysis to ascertain the percentage of fine Para, by estimation of extractive matter, which is specified not to exceed 5 per cent. of the compound, so as to exclude lower grades of rubber.

With regard to Mr. Langan's tests, however, it may be pointed out that the elasticity of the cheaper rubber can be increased by treating its surface with chloride of sulphur in carbon bisulphide.

The hydrochloric acid which is usually present in cables so treated is most dangerous to durability. This, however, refers chiefly to the "pure" rubbers as used next the copper.

In view of the occasional use and deleterious effects of rubber substitutes, such as oxidised oil, waxes, &c., and the great difficulty of detecting their presence, it might be worth while to afford protection to buyers by laws similar to those applicable to food-stuffs.

This would mean publication of all ingredients and proportions used, and Government inspectors to make frequent visits to cable or rubber-mixing works.

Some cable-makers would doubtless object to disclose valuable trade secrets of mixtures used, but good makers would welcome the protection thus afforded against the unfair competition of inferior home or foreign manufactures. There would always remain also the element of manufacturing care and skill.

If there were various standard mixtures, engineers could select, and buyers would pay for, with confidence, the cables deemed most suitable for any particular duty or situation. Such provisions, together with the British standards of radial thicknesses and tests, would be of great advantage to the electrical industry.

Any engineer who wanted cables other than standard would, doubtless, have to be prepared to pay a special price, but would have confidence that he was getting what he specified and paid for.

It could not be urged against such a proposal that the making of cables being thus crystallised and fixed, the progress of new invention would be retarded. For new mixtures could always be bought and tried on their merits.

Meantime, it is well known that for rubber cables, nothing is so durable and satisfactory as fine Para rubber.

It is by no means certain that rubbers in common use to-day are so good as those used 20 years ago and earlier; the present writer has before him a sample of cable lapped with two layers of pure rubber which has been in use in a dry situation for 22 or 23 years. The rubber is as fresh and resilient as when new. Vulcanised cables of this period, however, were perhaps, not so uniformly well made as now.

Until the arrival of the ideal condition suggested, the ordinary buyer of rubber cable had best rely chiefly, first, on the insulation test, second, the elasticity test, and third, on the good reputation of certain manufacturers.

NOTE ON THE INDICATOR DIAGRAM OF THE WILLANS ENGINE.

THE indicator diagram of a Willans compound engine appears to be a stumbling block to many, and the chief trouble would seem to be that part of the diagram which is obtained from the receiver between the H. and L.P. pistons. The following is written in the hope that it may serve to enlighten such as now sit in darkness.

Fig. 1 shows cards as obtained from an engine running with about 145 lb. steam pressure in the steam chest. The H.P., diagram A, is taken with a 150-lb. spring, while B and C, the receiver and L.P. diagrams respectively, are taken with a 50-lb. spring.

At first sight it would seem—and it must be admitted with some show of reason—that, as the receiver diagram B represents a pressure on the underside of the piston, it should be subtracted from the H.P. diagram. In order to examine this question carefully, the H.P. diagram has been re-plotted to a scale of 50 lb., and placed in correct position above the other two at fig. 2. Let us now examine the various pressures at an instant T, as shown in fig. 2. We are at once tempted to lay the scale across the diagrams along the line T, and say that there was 78 lb. per sq. in. pressing the H.P. piston down, and 12 lb. per sq. in. pressing it up; net result equals 66 lb. per sq. in. downwards. This sort of thing arises from a little want of thought as to what the real function of an engine indicator is.

A moment's consideration will tell us that what the indicator diagram really shows is not the pressure inside the cylinder but rather, by the vertical height above the atmospheric line of any point on the curve, what was the difference

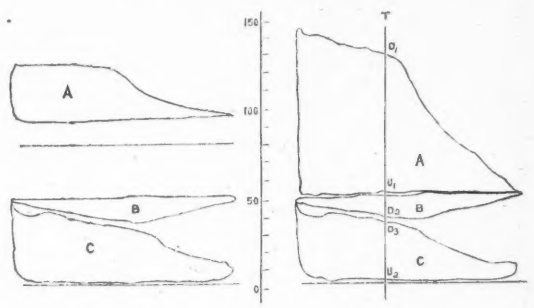


FIG. 1.

FIG. 2.

between the pressure of the air and the inside of the cylinder at that instant.

If we reconsider the diagram from the above point of view, we shall find that at the instant T on the down stroke the pressure on the top of the H.P. piston at D_1 was 128 lb. per sq. in., while at the same instant the pressure on the underside at D_2 was 38 lb. per sq. in. Hence the resultant downward pressure on the H.P. piston at this instant was 90 lb. per sq. in.

It will be seen that although the points U_1 and U_2 are on the same vertical line, they relate to pressures half a revolution later, and have no direct reference to the points D_1, D_2 and D_3.

In the case of the L.P. piston, since the engine under discussion is non-condensing, a diagram from the underneath side would simply result in a straight line, and there would be nothing to add. It will thus be seen that the work put into the engine is represented by the sum of the three diagrams A, B and C.

THE HUSTLER.

BY W. O. HORSNAILL, A.M.I.MECH.E., A.M.I.E.E.

IN these days of diminishing profits and keen competition, manufacturing engineering concerns look increasingly for energy and push on the part of their staff, and this attitude is perfectly justified, provided that the energy be displayed in the right direction. The appointment of a shop manager especially appeals to a board of directors as requiring the maximum of activity, and frequently a "hustler" is actually specified in the advertisement drawn out to fill such a post. Even if the word itself is not employed, the construction usually indicates this type of man.

The true hustler should have a complete grasp of the work carried on under his control, and if the undertaking be of such a size as to make it impossible for him to remember all the orders in progress, he will have prepared, and kept up to date, suitable written particulars indicating the progress on each job. A shop manager of this description will not necessarily appear to be bristling with energy, he may spend a considerable portion of his time dictating notes to the various foremen, urging forward certain portions of the work which have fallen behind; if these notes be disregarded, he will at once demand explanations, and will have a copy of the notes by

him to fix the dates and contents, thus eliminating any cause for dispute. Such methods of controlling a works are very much more effective than the plan of racing about and flurrying the foremen, probably causing them to forget one important job whilst urging forward another. Unfortunately, those in authority over the shop manager, do not always realise that the above system is the only satisfactory one by which a large concern can be carried on efficiently. They are apt to be impressed by a man who is always on the move, and never gives himself time to sit down and effectively grasp the details of every order which is being dealt with. A strong letter is, perhaps, received from some irate customer whose goods are overdue ; in such a case the imitation hustler runs down the shops, and has men taken off other important work and put on to this customer's order, regardless of the cost of disturbing men on half-finished jobs ; he will then probably promise an early delivery, which he can have no reasonable prospect of carrying out, but the customer is kept quiet for the time being, and the managing director will be firmly convinced that he really has the right man in charge of the shops at last. Contrast this procedure with what will be done by the systematic man in a similar case : he quietly has brought to him particulars of the progress made on all the orders in hand, and, after careful consideration of the claims of the customer in question, he will quote a delivery date which can be strictly adhered to. After this has been done the foreman concerned will be instructed in writing to take whatever action may be necessary to ensure delivery by the proper time.

In every way this is a much more satisfactory method of carrying on the business ; the customer may grumble at the time, but he will be subsequently much better pleased than if promises were made to him which could not be kept.

Happily the old-fashioned ways of managing by memory helped by postal reminders are gradually dying out, but men are still occasionally appointed to control large works whose capacity is limited to the management of a small number of men, and their success in this direction has obtained for them the more responsible post. The effect of such an appointment is not immediately felt, more especially if the works are dealing with large contracts with several months for delivery ; a man of the above stamp will carry on such work with apparent success for a long period until it is suddenly discovered that all orders are hopelessly behindhand and everything is in a muddle, resulting in the loss of prestige and a state of things which will occupy a first-class man 12 months or more in putting right. The post of shop manager is a most important one if a large undertaking is to be successful, and those in a position to make such appointments are now realising that a first-class organiser is required for such work, even if a high salary has to be paid to secure a suitable man.

Teutonic Enterprise in South America.—It is just a year since the German Transmarine Electricity Co., of Berlin, increased its share capital by £700,000 to £1,800,000 for the purpose of providing for the rapid development of the company's enterprises, and it is now proposed to make a fresh issue, which will bring the total capital up to £3,600,000. Although no information is given as to the reason for this new augmentation in the report for 1905, the latter states that during the year the company acquired a sub-station from the Buenos Ayres Electric Tramways Co., and concluded an agreement with it for the supply of current for the whole period of the concession. The company leased from the Buenos Ayres Grand National Tramways Co. the central station and plant of 2,075 H.P. and a battery of a capacity of 1,000 ampere-hours, in return for an annual payment of £5,000. On the other hand, the company leased to the Capital Traction and Electric Co. the metropolitan tramway for a yearly payment of £20,000 and two-thirds of the receipts in excess of a total of £22,500. In addition to this, the Transmarine Co. made arrangements with the Buenos Ayres Grand National Tramways Co. to furnish the latter with the whole of the power required for its lines, and also those of the four undertakings controlled by it, and a further agreement for the supply of energy was made with the Société Belgo-Argentine de Tramways de Buenos Ayres. The accounts of the Transmarine Co., which is also interested in the Chilian Electric Tramways and Light Co., show net profits of £173,246 for 1905, as compared with £88,670 in the previous year. It is proposed to pay a dividend at the rate of 9 per cent. on £1,694,000, as against 8 per cent. on £950,000 in 1904.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

12,369. "Improvements in electric telegraphy." I. Kitsee. May 28th. (Complete.)

12,379. "Improvements connected with the regenerative control of electrically-propelled vehicles." J. S. Raworth and A. Raworth. May 28th.

12,385. "Improvements in sparking plugs for electrically-fired internal combustion engines." The Electric Ignition Co., Ltd., and F. H. Hall. May 28th.

12,386. "Contact devices with a swinging plug for electrical circuits." W. Kreinsen. May 28th. (Complete.)

12,395. "An improved method of obtaining metals from their ores, or for heating substances, in electric furnaces, and electric furnaces for use therewith." N. A. Wallin. May 28th. (Complete.)

12,434. "Improvements in electrical resistances for electric heaters and the like." G. M. Newbery and H. Skipwith. May 29th.

12,435. "Throw-over switch for magneto and high-tension ignition as used on motor-cars and the like." H. Pickles. May 29th.

12,449. "Improvements in or connected with electrically-propelled railway vehicles or locomotives." S. B. Cottrell and J. A. Panton. May 29th.

12,450. "Improvements in electric switches." W. F. Jones. May 29th.

12,463. "Metering panel board." A. C. McWilliams. May 29th. (Complete.)

12,473. "Improvements in or relating to electric arc lamps." A. Heller, F. W. Stevens and W. W. Hare. (E. Cervanka, Austria.) May 29th.

12,477. "Controller regulator." W. Fairweather. (The Electrical Devices Co., United States.) May 29th. (Complete.)

12,486. "Improvements in telephony." D. C. Solomon. May 29th.

12,488. "A new or improved electrically-heated stove." Herde und Ofenfabrik Commandit-Gesellschaft F.A.C. Gutjahr & Co. (Date applied for under Patents Act, 1901, May 9th, 1906, being date of application in Germany.) May 29th. (Complete.)

12,491. "Improvements in dynamo-electric machines." B. G. Lamme. (Date applied for under Patents Act, 1901, June 2nd, 1905, being date of application in United States.) May 29th. (Complete.)

12,492. "Improvements in controllers for electric motors." H. U. Hart. (Date applied for under Patents Act, 1901, June 12th, 1905, being date of application in United States.) May 29th. (Complete.)

12,493. "Connection system for supplying alternating currents of variable voltage." R. P. Jackson. (Date applied for under Patents Act, 1901, June 12th, 1905, being date of application in United States.) May 29th. (Complete.)

12,497. "Improvements in and relating to control of dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 29th.

12,498. "Improvements in and relating to electric arc lamps." E. R. Grote and M. V. Ely. May 29th.

12,499. "Improvements in and relating to electric arc lamps." E. R. Grote and M. V. Ely. May 29th.

12,500. "Improvements in electric telegraph apparatus." S. G. Brown. May 29th.

12,505. "Improvements relating to electric switches adapted to be operated by the opening and closing of doors." F. C. Martin. May 29th.

12,537. "Improvements in or relating to electric junction and test boxes and the like." A. H. Marshall. May 29th.

12,567. "Improvements in shade devices for use in connection with gas, electric ligh., or with lamps." A. B. Williamson and T. Williamson. May 30th.

12,587. "Improvements in apparatus for measuring electrical resistances." J. W. Record and H. Bevis. May 30th.

12,597. "Improvements in and relating to single-phase alternating current motors." J. Bruncken. May 30th. (Complete.)

12,600. "Improvements in or connected with sparking plugs." W. H. Ingram and L. Ingram. May 30th.

12,622. "Apparatus for supplying current to electric tramways in mines subject to fire-damp." C. Ilgner. May 30th.

12,625. "Improvements in the electrolytic manufacture of metal wire, strip or the like." S. O. Cowper-Coles. May 30th.

12,626. "An improved process for the electrolytic manufacture of metallic wire or strip." S. O. Cowper-Coles. May 30th.

12,627. "Improvements in the electrolytic production of metallic strip." S. O. Cowper-Coles. May 30th.

12,628. "Improvements in the manufacture of copper wire, strip or ribbon." S. O. Cowper-Coles. May 30th.

12,638. "Improvements by means of electric current producers to be applied to hair and toilet brushes and the like." G. R. Thomson. May 30th.

12,685. "Improvements in electrical recording instruments." E. I. Everett and K. Edgcumbe. May 31st.

12,686. "Electro-magnetic friction clutch reversing gear." W. L. Spence. May 31st.

12,694. "Improvements in contact making and circuit controlling devices employed in connection with the signalling and point-shifting arrangements and the time recording devices of electric tramways and the like." Brecknell, Munro & Rogers, Ltd., and E. M. Munro. May 31st. (Complete.)

12,720. "Improvements in or relating to a combined system of electric mechanical power for the propulsion of automobiles or like purposes." H. F. Joel. May 31st.

12,721. "Improvements in or relating to a combined system of electric-mechanical power for the propulsion of automobiles or like purposes." H. F. Joel. May 31st.

12,730. "Improvements in and relating to machines for use in the manufacture of incandescent lamps." The British Thomson-Houston Co., Ltd. General Electric Co., United States.) May 31st.

12,731. "Improvements in and relating to machines for use in the manufacture of incandescent lamps." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) May 31st.

19,732. "Improvements in and relating to machines for use in the manufacture of incandescent lamps." The British Thomson-Houston Co., Ltd. The General Electric Co., United States.) May 31st.

12,742. "Improvements in electric illuminated signs, advertisements and decorations." H Michalke. June 1st.

12,748. "Improvements in telegraphy." I. Kitsee. June 1st. (Complete.)

12,758. "Improvements in means for supporting trolley wires employed in connection with electric traction in the event of breakage." S. J. Cooper and F. W. Colley. June 1st.

12,767. "Improvements in thermometrical and electrical devices for visibly or audibly announcing the attainment of a predetermined heat, applicable for other purposes." C. M. Harrison. June 1st.

12,773. "Improvements in terminals for electric accumulators." K. Rawlings Smith. June 1st.

12,777. "Improvements in magnetic compasses." C. Parker. June 1st.

12,778. "A new or improved magnetic compass." C. Barker. June 1st.

12,802. "Improvements in or relating to electric lamps." T. Atkinson and W. Spikesman. June 1st.

12,820. "Improvements in shaft bearings especially applicable to electric railway motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) June 1st.

12,821 "Improvements in methods of suspending the conducting wires of electric railways and the like." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts Gesellschaft, Germany.) June 1st.

12,825. "Improvements in or relating to the ignition of internal combustion engines." M. Kemp-Welch and P. Lyle. June 1st.

12,836. "Improvements in telegraphy." Marconi's Wireless Telegraph Co., Ltd. (M. I. Pupin, United States.) June 1st. (Complete.)

12,835. "Improvements in or relating to apparatus for the electrical production of heat for cooking and other purposes." A. F. Berry. June 1st.

12,855. "Improvements in electric switches." Allgemeine Elektricitats Ges. (Date applied for under Patents Act, 1901, June 5th, 1905, being date of application in Germany.) June 2nd. (Complete.)

12,862. "An electrical brake for railway trains." F. Morlock. June 2nd.

12,895. "Improvements in or relating to starters for electro-motors." L. Harris. June 2nd. (Complete.)

12,918. "Improvements in electrical controllers." C. T. J. Oppermann. June 2nd.

12,937. "A suction or pressure air nozzle for cleaning out plug-holes of telephone installations and the like." A. Serenyi. (Date applied for under Patents Act, 1901, June 2nd, 1905, being date of application in Germany.) June 2nd. (Complete.)

12,946. "Improvements in brush sockets for dynamo-electric machines." C. A. Parsons and A. H. Law. June 2nd.

12,947. "An improved regulator for electric fans." E. N. Bray and Bray, Markham & Reiss, Ltd. June 2nd.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

Electrically Controlled Valve Gear for Motive Power Engines. R. Kendal. 24,009A. January 31st. (Originally included in No. 24,009/04.)

1905.

Distribution of Electrical Energy. E. H. Hill. 8,906. April 27th.

Controlling System for Electric Railways. E. Zweigbergk. 8,913. April 27th.

Manufacture of Electrical Resistances. Electric Equipment and Securities, Ltd., and C. Ruzicka. 11,146. May 27th.

Vapour Electric Lamps. F. Harrison. 14,660. July 17th.

Transmitters for Automatic Telegraph Systems and the like. J. Gell. 18,102. September 7th.

Electric Incandescence Lamp with Filament of Metallic Tungsten. W. P. Thompson. (Deutsche Gasglühlicht Akt.-Ges. Auergesellschaft.) 18,814. September 18th.

Electrical Transmission of Power on Motor Vehicles and Boats. H. McNulta. 21,038. October 17th. (Date applied for under International Convention, December 10th, 1904.)

Electrical Distribution Systems. A. J. Boult. (J. L. Woodbridge.) 23,934. November 20th.

Electric Furnaces. Soc. Anon. Electrometallurgique. (Procédés P. Girod. 25,174. December 4th.

Control of Electric Motors. W. A. Clatworthy, A. Holmes, J. H. Holmes, L. W. Holmes and E. Holmes. 27,242. December 30th.

Filaments for Electric Incandescent Lamps. E. L. Frenot. 8,891. April 27th. (Date applied for under International Convention, May 7th, 1904.)

Trolley Heads for Electric Traction or the like. E. E. Feather, G. R. Feather, S. Feather and J. W. Astley. 9,162. May 1st.

Apparatus for Controlling the Supply of Energy from Alternating Current Electric Generators to Alternating Current Electric Motors. A. P. Wood. 9,279. May 3rd.

Electric Switch or Protective Circuit Breaker. L. R. Gleason. 9,303. May 3rd.

Method for Equalising Electrical Power when the Power Required is of an Intermittent or Variable Character. R. Braun. 9,467. May 5th.

Skates or Collectors for Electrically Driven Vehicles Operated by any Surface Contact Stud System. R. Brown. 9,508. May 5th.

Apparatus for Making and Breaking Electric Circuits. F. Smith. 9,565. May 6th.

Combined Portable Electric Battery and Induction Coil. B. Seacombe. 9,577. May 6th.

Field Telephone and Telegraph Apparatus. P. J. Kenny. (E. Molyneux.) 9,702. May 8th.

Apparatus for Controlling the Supply of Energy from Alternating Current Electric Generators to Alternating Current Electric Motors. A. P. Wood. 9,739. May 9th.

Appliances for Use in Connection with the Electric Ignition Systems for Internal Combustion Engines. C. T. B. Sangster. 9,815. May 10th.

Means for the Regulation of Speed of Compensated Single-Phase Motors. Bruce Peebles & Co. and J. L. La Cour. 9,839. May 10th.

Apparatus for Measuring Electrical Resistances. Evershed & Vignoles, Ltd., and S. Evershed. 11,415. May 31st.

Protective Devices for Alternating Electric Current Systems. British Thomson-Houston Co. (General Electric Co.) 11,626. June 2nd.

Adjustable Electrical Resistances. G. Harrison. (Electric Railway Improvement Co.) 13,954A. February 19th. (Date applied for under Rule 5, Patents Rules 1905, July 6th, 1905.)

Mercurial and other Metallic Vapour Electric Lamps. F. Harrison. 14,033. July 7th.

Prepayment Meters. British Thomson-Houston Co. (General Electric Co.) 15,859. August 2nd.

Electric Projecting Lamps Using Nernst Filaments. L. Kamm. 16,471. August 14th.

Wireless Telegraphy. G. Marconi and Marconi's Wireless Telegraph Co. 16,655. August 16th.

Current Takers or Trolleys for Overhead Wires of Electric Railways and the like. O. Hoffmann. 18,051. September 6th. (Date applied for under International Convention, September 9th, 1904.)

Gas or Vapour Electric Lamps. W. Heraeus and H. Heraeus. 18,264. September 9th. (Date applied for under International Convention, October 14th, 1904.)

Apparatus for Electrically Operating Railway Carriage or like Doors and for Operating Locks in Connection Therewith. A. Craven. 19,989. October 3rd.

Magneto-Electric Apparatus for Igniting the Charge in Internal Combustion Motors. M. De Saint-Romain. 21,268. October 19th. (Date applied for under International Convention, April 27th, 1905.)

Protecting Device for Shunt Field Windings of Electrical Machines where Shunt Regulators are Used. T. Edge. 21,707. October 25th.

Continuous Current Arc Lamps Particularly Applicable to Searchlights, Projection Lamps, and the like. P. Muller. 27,251. December 30th. (Date applied for under International Convention, December 31st, 1904.)

Electric Group Time Fuses. H. H. Lake. (The Fabrik Elektrischer Zünder Ges.) 9,966. May 11th.

Brushes for Dynamo-Electric Machines. K. Koch. 11,391. May 31st.

Electric Block Railway Signalling and Train Control System. J. A. Whyte. 11,840. June 6th.

Electric Tail Lamps for Motor Cars. Jackson. 12,100. June 9th.

Electrolytic Apparatus. G. G. Hepburn and Mather & Platt, Ltd. 12,221. June 13th.

Means for Regulating Dynamos. H. Leitner. 12,615. June 19th.

Wireless Telegraphy. G. Marconi and Marconi's Wireless Telegraph Co. 14,788. July 8th.

Apparatus for Controlling and Operating the Points of Electric Railways and Tramways. W. H. Turner, R. E. Dixon and T. B. Stewart. 15,546.

Electrical Ignition Gear for Internal Combustion Engines. F. R. Simms. 16,179. August 8th.

Electrical Contact Makers and Breakers Particularly for Use in Conjunction with Internal Combustion Engines. F. H. de Veulle. 17,286. August 26th.

Alternating Current Electric Motors. Akt.-Ges. Brown, Boveri & Co. 20,772. October 13th. (Date applied for under International Convention, October 17th, 1904.)

Manufacture of Magnetic Materials. R. A. Hadfield. 22,130. October 30th. (Date applied for under International Convention, June 8th, 1905.)

Method of Securing or Attaching a Wire Supplying Electricity to a Terminal. A. A. Lines. 21,870. October 27th.

Electric Circuit Breakers for Alternating Currents. Elektrizitats Act.-Ges. vorm. W. Lahmeyer & Co. 23,624. November 16th. (Date applied for under International Convention, December 22nd, 1904.)

Electric Ignition Systems for Internal Combustion Engines. J. J. H. Sturney. (Duryea.) 26,032. December 14th.

Telegraphs for Transmitting Orders. Siemens & Halske Akt.-Ges. 26,072. December 14th. (Date applied for under International Convention, December 14th, 1904.)

Application and Distribution of Electric Motive Power, Particularly for Use in Starting Machinery and for Similar Purposes. G. W. Mascord. 5,059. March 10th.

Electric Regenerative Battery. Post-dated May 31st, 1905. W. H. Fellows, E. T. Pickup and W. Tice. 7,133. April 4th.

Apparatus for Compounding Synchronous Alternating Current Machines. Bruce Peebles & Co. and J. L. La Cour. 9,837. May 10th.

Electric Current Rectifiers Applicable also for Lighting Purposes. British Thomson-Houston Co. (General Electric Co.) 10,214. May 15th.

Holders for Incandescent Electric Lamps. L. Sunderland and P. C. Pillinger. 10,288. May 16th.

Dynamo-Electric Machines. P. M. J. Boucherot. 10,299. May 16th. (Date applied for under International Convention, May 17th, 1904).

Iron Standard for Fixing Guard Boards on Electric Railways. G. T. Trinder and T. D. Cramb. 10,341. May 17th.

Methods of Charging and Discharging Electric Accumulators in Systems of Electric Distribution. G. S. Ellis and A. M. Taylor. 10,495. May 19th.

Wireless Telegraphy with Earth Currents. L. Zehnder. 10,601. May 20th. (Rights under Patents, &c., Act, 1901, not granted.)

Socket Connectors for Electric Light Cables. H. E. Saxby. 12,003. June 8th.

Mounting of Electrotype, Stereotype, and other Printing Surfaces. J. A. Corey. 12,524. June 16th.

Electro-Magnetically Actuated Friction Reversing Gear. F. Jensen. 13,816. July 4th.

1906.

Electrically Fired Internal Combustion Engines. H. Pieper. 1,699. January 23rd. (Date applied for under International Convention, January 24th, 1905.)

Control of the Electric Circuits in Systems of Electric Traction. A. Raworth. 1,830. January 24th.

Safety Appliances for Electric Circuits. Siemens Bros. & Co. (Siemens Schuckertwerke G.m.b.H.) 3,541. February 13th.

Oscillaphones or Hertzian Wave Responsive Devices. W. W. Massie. 4,221. February 20th.

Starting Switches, Rheostats or Controllers, for Electric Motors. A. Holmes, J. H. Holmes, L. W. Holmes, E. Holmes and G. J. Ralph. 4,773. February 27th.

Alternating Current Electro-Magnets. F. Conrad. 7,490. March 28th. (Date applied for under International Convention, April 3rd, 1905.)

Electro-Magnets. R. P. Jackson. 7,491. March 28th. (Date applied for under International Convention, April 3rd, 1905.)

Accumulator Batteries. Accumulatoren-Fabrik Akt.-Ges. 8,352. April 6th. (Date applied for under International Convention, April 7th, 1905.)

Electrically Operated Photographic Copying Apparatus. O. Lienekampf. 235. January 3rd. (Date applied for under International Convention, October 23rd, 1905.)

Method of and Apparatus for Influencing an Electric Circuit in Dependence upon the Load of a Continuous Current Motor Situated in another Circuit. Siemens Bros. & Co. (Siemens Schuckertwerke G.m.b.H.) 376. January 5th.

Variable Electric Resistance Devices. W. R. Lambert. 918. January 12th.

Inspection Sight for Electric Ignition Spark. A. F. White. 2,853. February 6th.

Construction of Alternate or Change-Over Electric Tumbler Switch. E. T. Davies. 2,928. February 7th.

Combined Telephone Receivers and Microphones. C. E. Ljungman, R. O. P. Berglund and W. A. W. E. Hjorth. 3,224. February 9th.

Trolleys or Collectors for Electricity. E. D. Rockwell. 5,883. March 10th. (Date applied for under International Convention, March 11th, 1905.)

Vapour Electric Apparatus for Rectifying Electric Currents. P. H. Thomas. 6,557. March 19th. (Date applied for under International Convention, March 30th, 1905.)

Electrical Switches. J. Whyte. 368. January 5th.

Spring Drive Suitable for Steam, Petrol, and Electrically Propelled Vehicles and other Machines. C. B. Hannan. 2,669. February 3rd.

Switches for Electric Bells and Buzzers. B. H. Thorogood. 4,190. February 20th.

Control of Electric Switches and Operating Mechanism Therefor. P. S. Pevear. 4,711. February 26th. (Date applied for under International Convention, February 27th, 1905.)

Electric Furnaces for Treating Gases by Means of Electro-Magnetically or Electro-Dynamically Actuated Electric Arcs. A. J. Petersson. 9,164. April 18th.